ELECTRIC VEHICLE CONVENTION, SAN FRANCISCO, FEB. 19TH & 20TH

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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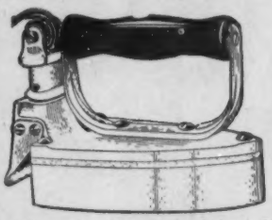

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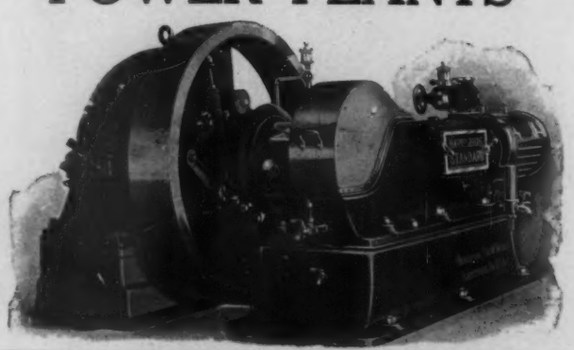

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VOLUME XXII. SAN FRANCISCO, FEBRUARY 27, 1909 NUMBER 9

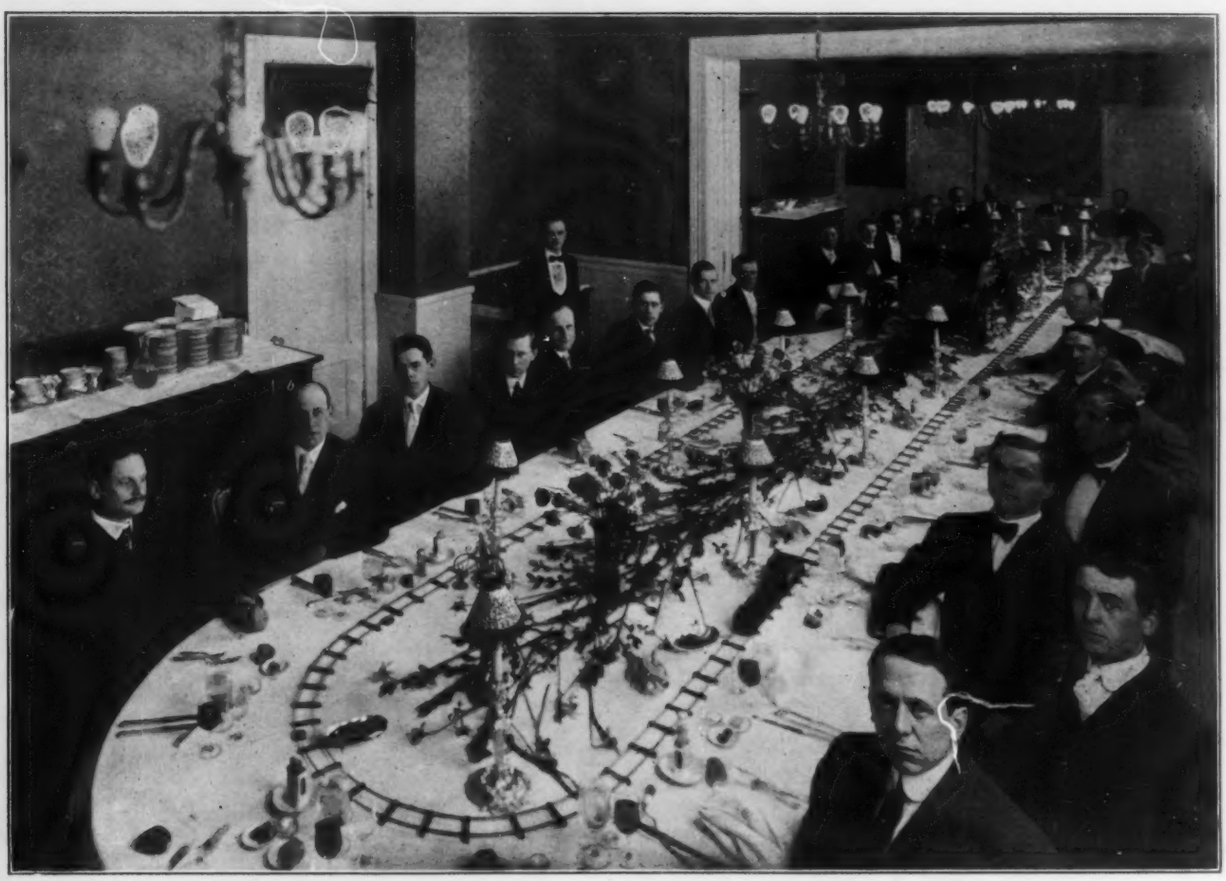
CONVENTION OF PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION

Responsive to invitation, a number of Pacific Coast representatives of distributers of electric vehicles and their equipment, together with several central station men, met at the St. Francis Hotel, San Francisco, February 19th and 20th, 1909. Excellent papers were read by some of the delegates and a unity of spirit created that resulted in the formation of a permanent organization to be known as the Pacific Coast Electric Vehicle Association.

The prime object of this organization is to promote the sale of electric vehicles. Its first work is to convince the central station companies of the desirability of battery charging as a power consumer, entitled to low current rates. With cheap electric power assured, sales will be encouraged. The full scope of the organization can be best appreciated by reading the record of the first annual meeting as set forth hereafter.

The Convention was called to order at 10:30 a. m. Friday, February 19th with an address of welcome and explanation of purpose by Mr. R. B. Daggett, manager of the San Francisco office of the Electric Storage Battery Company. During the course of the day papers were read as follows:

"Electric Vehicles," by Mr. R. B. Daggett; "Mercury Arc Rectifiers," by Mr. R. M. Alvord; "Vehicle Batteries," by Mr.



Banquet Given by Electric Storage Battery Company to Delegates Pacific Coast Electric Vehicle Association.

Geo. R. Murphy; 'The Relation of Central Station Companies to the Automobile Business," by Mr. Fred T. Kitts; "The Electric Vehicle Motor," by Mr. J. T. De Remer. These papers brought out much valuable information in the course of the discussion that followed them.

For the purpose of effecting a permanent organization the chair appointed as a committee to draw up a constitution and by-laws, Fred T. Kitt, A. C. Downing and A. H. Halloran.

In the evening the delegates were the guests of the Electric Storage Battery Company at an enjoyable theatre party given at the Orpheum. Later the party adjourned to the Louvre where a sumptuous supper was spread under the auspices of the Studebaker Company.

Let Watts, Amperes, Volts, all be gone,
Come eat, drink, be merry, join the song;
"Studebaker" as host, desires this to be
An evening for acquaintances, so be free.

The "song" was an appropriate parody on a popular automobile ditty.

A small model automobile was placed at each plate as a souvenir of the occasion and every encouragement given for the promotion of good-fellowship.

On Saturday morning, February 20th, business was resumed with the reading of a paper on "Commercial Electric Vehicles," by Mr. A. C. Downing, and one on the "Electric Garage," by Mr. S. P. Reed. The discussion that followed brought out considerable data on electric pleasure vehicles. The meeting adjourned at one o'clock until the banquet at seven.

"Babcock" Electric Climbing Powell-Street Hill.

During the interim the visitors inspected electric automobiles and their equipment. Several test runs were made by a "Babcock" machine on the Powell street hill. This is one of the heaviest grades in San Francisco and it was demonstrated to the satisfaction of everyone present that the electric automobile is a good hill-climber. Six trips were made in rapid succession, the car taking the heavy grade with ease.

A banquet on Saturday evening was given to the delegates by the Electric Storage Battery Company. The table was beautifully decorated; occupying the center was a large model automobile. An electric car running on a track around the table, supplied with current by a storage battery, carried messages and cigars to the guests and caused considerable amusement. Witticisms and fun-making took up the early part of the evening, but at the conclusion of the dinner a report was asked from the committee on constitution and by-laws, which reported as follows:

Constitution and By-Laws of the Pacific Coast Electric Vehicle Association.

ARTICLE I.

Name.

This Association shall be known as the Pacific Coast Electric Vehicle Association.

ARTICLE II.

Object.

To promote the use of electric vehicles.

ARTICLE III.

Membership.

Any person or any member or employee of a company engaged in the manufacture of electric vehicles, their equipment or distribution, in the sale of electric power, in furthering the publicity of the same, or any owner of an electric automobile, is eligible for membership in this Association.

ARTICLE IV.

Officers and Their Duties.

The officers of this Association shall consist of President, Vice-President and Secretary-Treasurer, and their duties shall be those usually appertaining to such, except that they shall constitute the Governing Board and shall appoint committees and call meetings.

ARTICLE V.

Elections.

Section 1. All officers shall be elected for the term of one year, except in the case of vacancies, when the term of office shall be for that part of the unexpired term only.

Sec. 2. Any member of good standing shall be eligible for election to any office.

Sec. 3. When from any cause any office shall become vacant, it shall be filled by election as soon as practicable after the receipt of notice of said vacancy.

Sec. 4. Election shall be by ballot, the first ballot being a nomination. The ballots shall continue until one nominee has the majority of the votes of those present.

ARTICLE VI.

Amendments.

Section 1. Amendments to the Constitution can be made by a two-thirds vote of all members.

Sec. 2. Amendments to the By-Laws can be made by a two-thirds vote of the members present at any meeting.

BY-LAWS.

ARTICLE I.

Membership.

Section 1. Applicants who are eligible shall become members upon payment of the admission fee of $5.00.

Sec. 2. The dues shall be $2.00 per annum, payable on March 1st of each year, excepting that charter members shall be exempt from the first year's dues. Those admitted before July 1, 1909, shall be charter members.

ARTICLE II.

Special Meetings.

Special meetings shall be called by the board at their discretion, or upon the application of five members, when no business shall be transacted other than that stated in the call.

ARTICLE III.

Meetings.

Section 1. The regular meetings of the Association shall be held within the first week of February of each year.

Sec. 2. The place of the next meeting shall be determined by the members one year in advance.

ARTICLE IV.

Rules.

Roberts' Rules on Order shall govern the meetings of the Association and the Governing Board, except as otherwise provided for in these By-Laws.

Order of Business.

1. Roll-call.
2. Reading the Minutes.
3. Report of the Secretary-Treasurer.
4. Report of Committees.
5. Unfinished Business.
6. New Business.
7. Adjournment.

ARTICLE V.

Quorum.

A quorum shall consist of fifteen members.

These were adopted and signed by the following, a number of delegates being unavoidably absent:

Geo. E. C. Holberton, San Francisco Gas and Electric Company, 925 Franklin street.

Fred T. Kitt, 316 Twenty-second street, Sacramento, Cal.

A. G. Jones, General Electric Company San Francisco.

A. Scraba, Bay Cities Electric Company, Oakland.

W. N. Stevenson, care of E. R. Braley, Pasadena, Cal.

W. D. Vance, Bay Cities Electric Company, Oakland.

A. C. Downing, Studebaker Company, South Bend, Ind.

R. M. Alvord, General Electric Company, San Francisco.

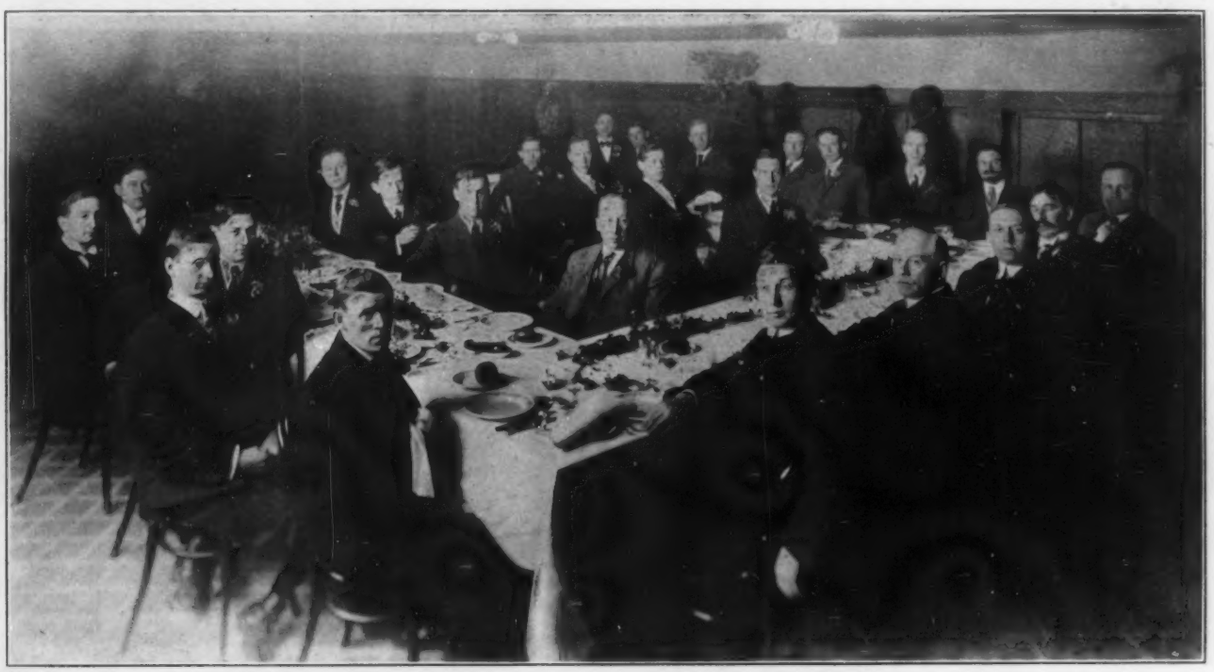
William Hughes, Bay Cities Electric Company, Oakland.

Geo. R. Murphy, Electric Storage Battery Company, San Francisco.

W. W. Briggs, Westinghouse Electric and Manufacturing Company, 168 Second street, San Francisco.

G. A. McDougald, 568 Fairmount avenue, Oakland.

Sirch Electrical and Testing Laboratories, Los Angeles, California.



Supper Given Delegates by Studebaker Bros. Company.

Rauch & Lang Company, F. W. Pfaffman, Manager, 2120 West Seventh street, Los Angeles.

I. G. Perin, Western Electric Vehicle Company, Oakland.

"Journal of Electricity, Power and Gas," San Francisco.

R. B. Daggett, Electric Storage Battery Company, San Francisco.

T. H. Dooling, Electric Storage Battery Co., San Francisco.

The next business being the election of officers, the following were chosen:

President, R. B. Dagget, Manager S. F. Office Electric Storage Battery Co.

Vice-President, A. C. Downing, Manager Electric Automobile Department, Studebaker Bros. Co., San Francisco.

Secretary-Treasurer, A. H. Halloran, Managing Editor Journal of Electricity, Power and Gas.

After a spirited contest, Oakland, California, was selected as the next meeting place. The "Journal of Electricity, Power and Gas" was chosen as the official organ of the Association. The Convention then adjourned after a most enjoyable and successful session. The attendance was about fifty and included representatives from all California.

THE ELECTRIC VEHICLE.[1]

BY R. B. DAGGETT.[2]

The electric vehicle has been on the market for about twelve years. It has been prominent during the last eight years. The greatest strides have been made, however, during the last five years.

As is usual with new devices, the first electric vehicles put on the market were crude and imperfect in many particulars. These imperfections reduced their radius of action so that their adaptability was somewhat limited. The battery being the source of power, the blame for lack in mileage naturally attached to its alleged lack in capacity and great weight per unit of output.

The evolution of the vehicle battery will be fully described in the paper to be presented later by Mr. Murphy. You will learn that there has been little change in the type of battery and that the capacity per unit of weight has not been greatly increased during the last eight years until very recently. The new thin type of plate which has been put on the market during the last year has increased the capacity of batteries per unit of weight about 25%, and in some special cases to a still greater degree.

The greatest improvement in the electric vehicle has been made with respect to the design of the moving parts, such as motor, bearings, etc., and also in the quality of workmanship and material. These latter improvements have increased the efficiency of drive very materially, thereby increasing the mileage from two to three hundred per cent with the same expenditure of energy, and hence with the same battery equipment. This increased mileage is due partly to the increased efficiency of operation, thus requiring a smaller amount of energy, and also by decreasing the discharge rate of the battery, thereby increasing the number of ampere hours available.

It may interest you to know the approximate number of electric vehicles in use today in some of the cities throughout the country. I have therefore tabulated them, as follows:

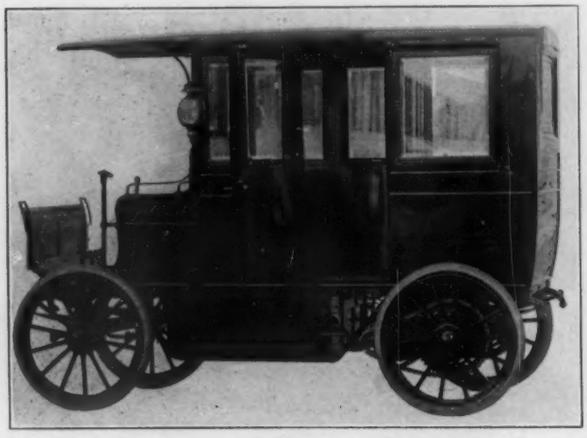
[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Manager S. F. Office Electric Storage Battery Co.

	Commercial.	Pleasure.
New York	900	750
Chicago	50	3000
Boston	71	86
Cleveland	15	850
St. Louis	70	200
Atlanta	..	60
Los Angeles	25	150
Pasadena	..	200
Seattle	5	60
Portland	..	20
Oakland	..	30
Sacramento	..	5
San Jose	..	5
San Francisco	1	5

The two principal uses of electric vehicles are for pleasure and for commercial purposes. The pleasure vehicle will average about 70 miles at ordinary speed on good roads. The commercial vehicle may be divided into two classes—the runabout, having a mileage about the same as the pleasure vehicles, and trucks and delivery wagons, capable of hauling heavy loads, the latter having a mileage of from 25 to 40. The electric truck has demonstrated its value and economy in operation in many cities of the country. The city nearest at hand in which electric trucks have been operated successfully is Los Angeles. The Los Angeles and Redondo Railway Company operates electric trucks for hauling freight, and they have data which indicates that the electric truck is the most economical device for the purpose.

The electric vehicle manufacturers find, on approaching prospective customers for the purpose of convincing them of the feasibility of changing from horse drawn to electrically driven trucks, that the cost of equipment and operation of the electric truck seems large. Upon investigation it is found that the reason for this is, that few companies operating horse drawn vehicles keep records of the costs involved, and that hence the costs are greater than are assumed. This statement applies as well to the lighter forms of vehicles. It is necessary, therefore, for the manufacturer and distributer of electric vehicles not only to study the costs of his product but also that of all other forms of vehicles, in order to put before the prospective buyer a convincing argument.



Electric Bank Wagon or Pay Car.

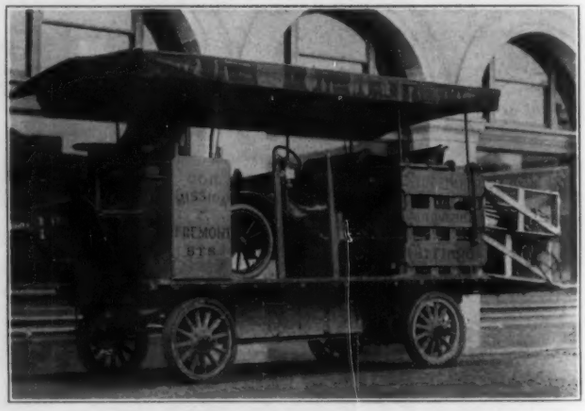
There is practically no competition between the vehicles driven by gas engines and those driven by electric motors. Their fields are quite separate and distinct. The gasoline car is adaptable for touring purposes requiring a large radius of action, whereas the electric vehicle is suitable only for use within a restricted area. Investigation, I think, will show that large numbers of gas engine driven vehicles are used for business and pleasure for short distances in the larger cities. I believe it can be demonstrated that the gas engine driven vehicle can be replaced in many cases by the electric vehicle for city use, with an increase in economy of operation, ease and cleanliness in manipulation, and a decrease in repair bills. Increased cleanliness and superior sanitary conditions of the streets, especially in our largest cities, deserve serious consideration. Power driven vehicles, and especially electric vehicles which are both clean and noiseless as compared with horse driven vehicles, make for the improved conditions along these lines.

In the city of Boston recently, a test of the comparative adaptability of the electric and gasoline vehicles for moving about congested districts was made. A route was determined upon and at the same moment the electric and gasoline started in opposite directions to make the predetermined circuit. The electric arrived at the starting point fifteen minutes ahead of the gasoline car.

Mr. Pfaffman in his paper will bring out the tire problem. Experience has demonstrated that the mileage to be obtained by electric vehicles is largely dependent upon the type of tire used. In fact, the tire problem in connection with all traction vehicles seems to be an important one, and one which is receiving a great deal of attention from the tire manufacturers. Great improvements have been made and no doubt others are contemplated.

The electric vehicle having been demonstrated as a success, the central power station companies furnishing current in the more important cities should at once appreciate the opportunity of greatly increasing their output without materially increasing the capacity and hence the investment on their generating plants.

Electric vehicles are most usually either charged during the middle part of the day or late at night. It is hardly necessary to ever charge vehicle batteries during the peak of the load. Hence, if Central Station Companies can encourage the use of the electric vehicle, they will, at only the expense of advertising, practically obtain storage batteries connected to their system for the purpose of increasing the load when the ordinary demand for current is small. This problem of increasing the load factor is one of the most important ones before the electric power companies today.



Electric Truck Which Has Been in Continual Operation Over San Francisco Streets Since January 10, 1907.

The first move by the Central Station Companies toward encouraging the use of electric vehicles should be their purchase for their own use, for emergency, construction wagons, etc. Many of the larger eastern central station companies have taken this step and I think upon investigation it will be found that not only are they justified in making the purchase for the purpose of convincing the public of the feasibility of operating the electric vehicle, but that these vehicles have increased their economy of operation.

Further methods of procedure suggested are advertising by electric signs and through the newspapers the fact that the company is prepared to make special rates for charging automobile batteries and to at least assist in establishing convenient charging stations throughout their territory.

The subjects above outlined will be taken up more thoroughly in the papers to be presented at this convention, it not being the purpose of this paper to treat any of the subjects mentioned exhaustively, but to direct your thought by bringing to your attention the salient points regarding the electric vehicles.

MERCURY ARC RECTIFIERS.[1]

BY R. M. ALFORD.[2]

Before the introduction of the mercury arc rectifier there existed a demand for a compact, efficient and low cost device for rectifying alternating current for various purposes, particularly for charging storage batteries and electric vehicles. That this demand has been filled by the mercury arc rectifier is evident by the fact that there are nearly thirty-five hundred rectifiers in satisfactory operation throughout the world.

A modern installation of a mercury arc rectifier charging an electric automobile is shown in Fig. 1. It is needless to say that this shows a marked improvement over some of the earlier installations.

The mercury arc rectifier is no doubt the best device that has been produced, particularly on account of its flexibility and reliability in operation and the fact that it is so simple to operate. The simplicity of its operation permits its installation at any point whether skilled or unskilled labor is available for operation, as various letters from users who are non-technical and non-electrical show.

It is not the intention of this paper to go very deeply into the theory of the rectifier. The mathematical demonstration of the law of the rectifier is quite complex, and neither time nor space will permit its discussion. A few simple statements in regard to theory may, however, be of interest.

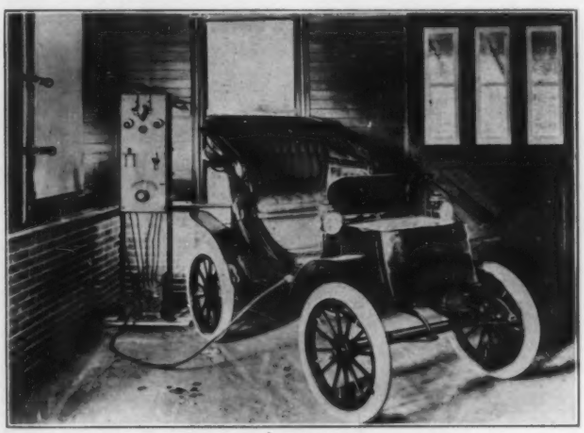


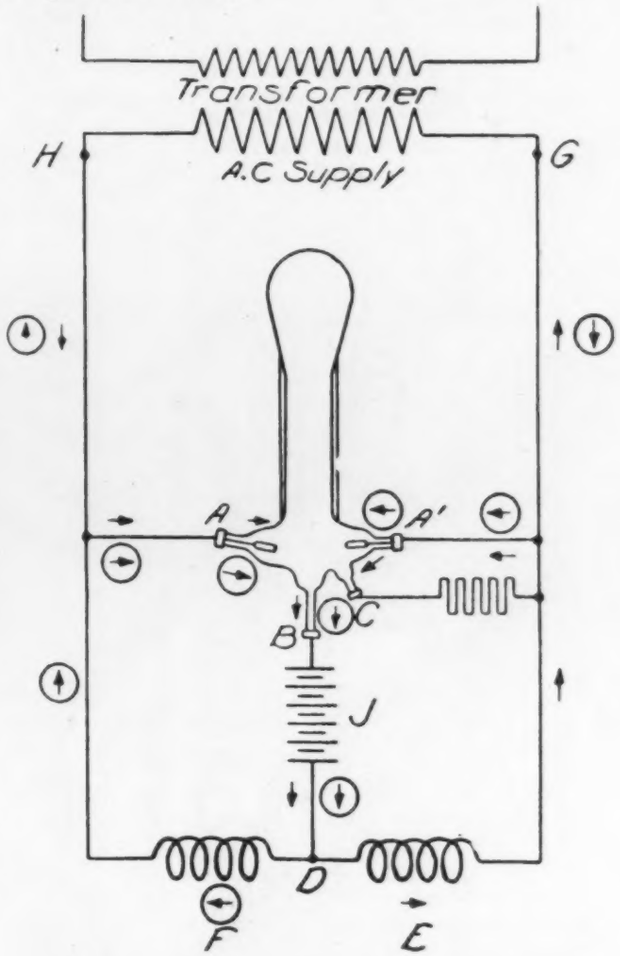
Fig. 1. Modern Automobile Charging Outfit.

In an exhausted tube having one or more mercury electrodes, ionized vapor is supplied by the negative electrode or cathode, when the latter is in a state of "excitation." This condition of excitation can be kept up only as long as there is current flowing toward the negative electrode. If the direction of the voltage is reversed, so that the formerly negative electrode is now positive, the current ceases to flow, since in order to flow in the opposite direction it would require the formation of a new negative electrode, which can be accomplished only by special means. Therefore, the current is always flowing towards one electrode, the cathode, which is kept excited by the current itself. Such a tube would cease to operate on alternating current voltage after half a cycle if some means were not provided to maintain a flow of current continuously towards the negative electrode.

In the General Electric rectifier tube, there are two graphite electrodes (anodes), A, A^1, and one mercury cathode, B, (Fig. 2). Each anode is connected to a separate side of the alternating current supply and also through reactances to one side of the load. The cathode is connected to the other side of the load. As the current alternates, first one anode and then the other becomes positive and there is a continuous flow of current towards the cathode, thence through the load and back to the opposite side of the supply through a reactance. At each reversal the reactances discharge, thus maintaining the arc until the voltage reaches the value required to maintain the current against the counter electromative force of the load and also reducing the fluctuations in the direct current. In this way a true continuous current is produced with very small loss in transformation.

A small electrode, C, connected to one side of the alternating circuit through resistance, is used for starting the arc. A slight tilting of the tube makes a mercury bridge between B and C, and draws an arc as soon as the arc returns to a vertical position.

That there may be no misapprehension, I wish to emphasize particularly what will be noted from the above, i. e., that the recifier is designed that the entire alternating current wave is used. This, of course, means that the rectifier has twice the efficiency that would be obtained if only one-half of the alternating current were used.



ELEMENTARY DIAGRAM OF CONNECTIONS
Fig. 2.

An idea of the operation of the mercury arc rectifier may be obtained from Fig. 2. Assume an instance when the terminal H of the supply transformer is positive, the anode A is then positive and the arc is free to flow between A and B, B being the mercury cathode. Following the direction of the arrows still further, the current passes through the load J, through the reactance coil E, and back to the negative terminal G, on the transformer. A little later, when the impressed E. M. F. falls below a value sufficient to maintain the arc against the counter electromotive force of the arc and the load, the reactance E, which has been charging, now discharges, the discharged current being in the same direction as formerly. This serves to maintain the arc in the rectifier until the electromotive force of the supply has passed through zero, reverses and builds up to such a value as to cause A^1 to have a sufficiently positive value to start the arc

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]General Electric Co., San Francisco.

between it and the cathode *B*. The discharge circuit of the reactance coil *E* is now through the arc A^1 *B*, instead of through its former circuit. Consequently, the arc A^1 *B* is now supplied with current, partly from the transformer, and partly from the reactance coil *E*. The new circuit from the transformer is indicated by the arrows enclosed in circles.

Figs. 3 and 4 give a very good idea of the latest commercial set that has been developed for charging vehicle batteries. The set consists of four essential parts, i. e., panel tube, regulating compensator and reactance.

The panel is entirely self-contained, requiring only to be connected to the secondaries of the supply transformer and to the load. Completely equipped, it requires a floor space of approximately 16 x 18 inches, and has a height of 64 inches. On it is mounted a direct current voltmeter and anmeter, a double pole switch for connecting to the supply circuit, a direct current overload circuit breaker for the load, and the necessary switches for starting and operating the rectifier. A starting resistance, on which the rectifier starts before connection to the actual or working load, is mounted on the back of the panel and is operated by a single pole, double throw spring starting switch on the panel. An auxilliary spring switch mechanically operated by this starting switch, automatically opens the starting anode circuit as soon as the starting switch handle is released.

Accurate voltage control is obtained by adjustments of a double regulating switch mounted on the front of the panel. This switch has two sets of contact buttons—six buttons in one set for rough regulation, and eleven buttons for fine regulation. With this switch it is possible to obtain a very wide regulation, practically independently of the current flowing. The contact buttons are connected to rough and fine regulation taps brought out from the regulating compensator mounted on the back of the panel. This is a different form of voltage control than that which has been used heretofore on mercury arc rectifiers, and tests have shown that it is an improvement over previous methods.

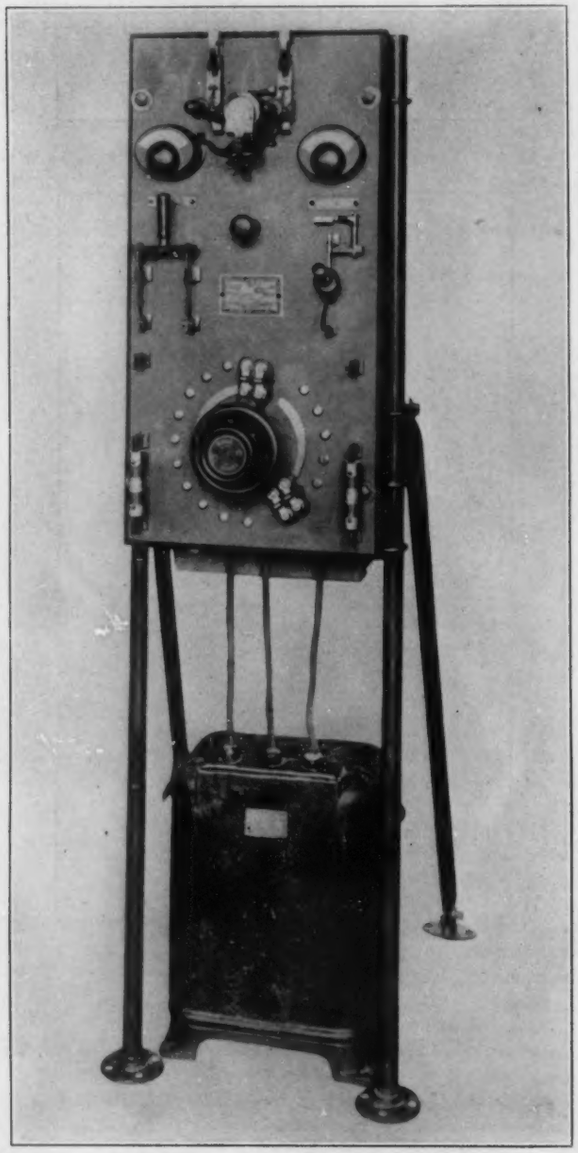


Fig. 3. Front View Mercury Arc Rectifier.

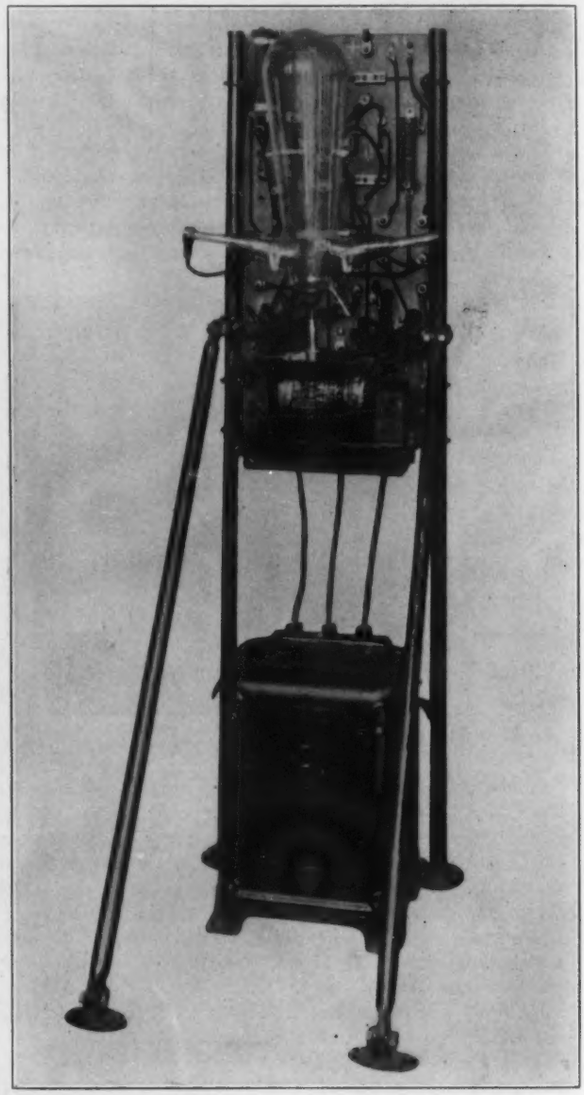


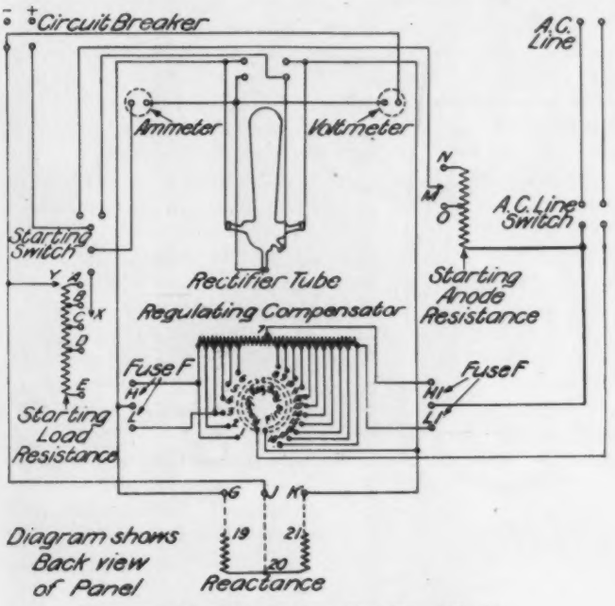
Fig. 4. Rear View Mercury Arc Rectifier.

The rectifier tube is an exhausted glass vessel containing two anodes, *A* A^1, (see Fig. 2 and Fig. 4), one cathode *B*, and one starting anode *C*. The terminals of the tube are provided with metal caps which protect the electrodes, thus reducing to a minimum the liability to damage. The tube is mounted in a holder on the back of the panel consisting of a moving member, so pivoted at its center that it can be rocked back and forth. A small hand wheel on the front of the board is connected to the tube-holder and serves to rock the tube in starting the arc. Two tubes are furnished with each rectifier set.

The reactance is connected directly to the regulating compensator as shown in Fig. 5, and stands on the floor directly under the panel. Three leads are brought out from the reactance to connection studs on the back of the panel.

The rectifier as made for charging electric vehicle batteries and other similar uses, is now furnished in four sizes, i. e., 10 amp., 20 amp., 30 amp., and 40 amp. This covers rectifiers with a single tube. As many as desired may be operated in multiple by the addition of certain auxiliary apparatus.

Rectifiers can be adapted to any commercial frequency and the standard outfits will operate satisfactorily on any frequency from 60 to 140 cycles inclusive. They are designed primarily, however, for 60 cycles, and a maximum direct current voltage will be obtained when operating at this frequency. When operating at 140 cycles the direct current voltage obtainable is somewhat



Connect G to 19, J to 20, K to 21
110 Volts A.C.
Connect M to O on Starting Anode Resistance

D.C. Volts	Position of Fuses F	Position on Rough Regulating Dial	Connections of Starting Load Resistance	
5 to 15	L - L1	1	Y to A	X to B
10 - 22	L - L1	2	Y - B	X - C
15 - 32	L - L1	3 or 4	Y - A	X - C
20 - 40	L - L1	5 - 6	Y - C	X - D
30 - 44	H - H1	1	Y - C	X - D
42 - 59	H - H1	2	Y - B	X - D
54 - 74	H - H1	3	Y - A	X - D
66 - 115	H - H1	4, 5 or 6	Y - D	X - E

220 Volts A.C.
Connect M to N on Starting Anode Resistance

30 to 64	L - L1	1 or 2	Y to B	X to D
47 - 85	L - L1	3 - 4	Y - A	X - D
60 - 100	L - L1	5 - 6	Y - D	X - E
87 - 117	H - H1	1	Y - D	X - E
110 - 148	H - H1	2	Y - C	X - E
133 - 179	H - H1	3	Y - A	X - E

Fig. 5.

lower. Rectifiers can also be supplied for operation on frequencies of 25 to 60 cycles, inclusive.

Rectifiers can be furnished to operate on any secondary commercial alternating voltage. The standard outfits, however, are designed for operation on either 110 or 220 volts alternating current, single-phase circuits. It has been found that for a range of direct current voltage from 30 to 115, 110 or 220 volts alternating current will give the best results, although from 110 volts A. C. as low as 5 volts direct current can be obtained.

In Fig. 6 will be found a curve showing the A. C. amperes required when operating a 30 amp. rectifier from 110 volts, 60 cycles A. C.

As the loss in the arc is constant, the efficiency, of course, varies with the direct current delivered, as will be seen in Fig. 6. These efficiencies hold up very high down to one quarter load, which is not true in the case of motor generator charging sets. At the same delivered direct current voltage, practically the same efficiencies would hold on the sets of other capacities previously mentioned. The efficiencies given in the curve, Fig. 6, are correct to within a few per cent.

The power factor as will be seen from Fig. 6, averages over 90 per cent.

The question is sometimes raised in reference to the effect of a pulsating current on storage batteries. This question has been submitted to a prominent storage battery manufacturer who replies as follows:

"We have sifted these matters down from time to time and our conclusion is, that when a given number of amp. hours goes into the battery at a certain rate, it makes no difference when it is plain direct current or the pulsating current from the rectifier." * * * * * *

"There have been so many rectifiers installed in the past few years that we have been enabled to obtain a pretty fair idea of their operation, and if there were any great differences in the effect upon the battery, it is inconceivable that we should not know of it by this time."

The only part of the rectifier set that can require maintenance is the tube. The average life of the tube under normal

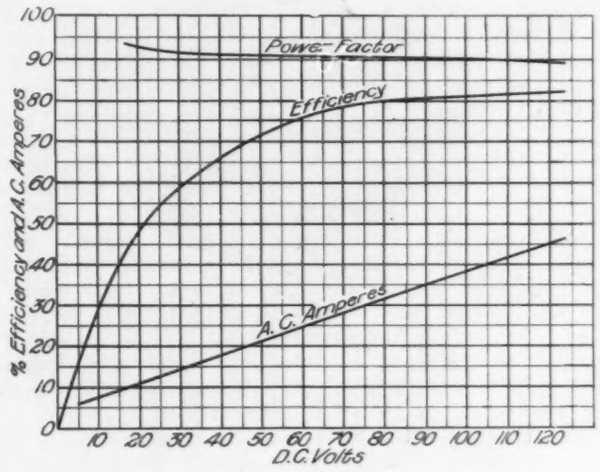


Fig. 6.

operating conditions, is about 600 hours. Tests at present indicate that the average life will be considerably above the figure cited. This will be appreciated from the fact that we have had reports showing a life of over 6,000 hours on a 10 amp. tube; 10,000 hours on a 20 amp. tube; 7,000 hours on a 30 amp. tube; and 6,000 hours on a 40 amp. tube. All these tubes were in commercial operation charging storage batteries.

As the cost of renewals is merely nominal and the other advantages of the rectifier are so numerous, the question of life is not at all serious, but in any case the saving in cost of energy due to the higher efficiency of the rectifier set over a motor generator charging set, is sufficient to pay for a new tube in approximately 300 hours, even in the case of a moderately low voltage battery.

Below is a single example of the saving in cost of operation of the mercury arc rectifier over a motor generator set when charging a 30 cell battery (an average size used in electric automobiles), the battery being charged in accordance with time and current recommended by the manufacturer.

Motor Generator Set.

The first part of charge is at 19 amp. and 70 volts average for 5 hours. Efficiency of set at this load—50 per cent.

Second part of charge is at 8 amp. and 74 volts average for two hours.

Efficiency of set at this load—33 per cent.

First part of charge=19x70x5=13.3 k.w. hrs. from service mains.
50%

Second part of charge=8x74x2=3.58 k. w. hrs. from service mains
33% Total 16.88 k.w. hrs. from service mains

When figured at 6 cents per k. w. hour equals 16.88x.06 equals $1.01 per charge.

Mercury Arc Rectifiers.

The first part of charge=19x70x5=8.52 k.w. hrs. from serv. mains
78%
Second part of charge=8x74x2= 1.48 k.w. hrs. from serv. mains
80% Total 10.00 k.w. hrs. from serv. mains
When figured at 6 cents per k.w. hour—10x.06—$.60 per charge.

Cost per charge—motor generator set.....	$1.01
Cost per charge—mercury arc rectifier.....	.60
Saving per charge	.41

With an average life figure of 600 hours, 7 hours per charge equals about 85 charges during life of tube.

Total saving during life of tube equals .41 x 85 = $34.85.

In this particular example the saving is sufficient to pay for a new tube in about 225 hours.

General experience has shown the rectifier to be durable and satisfactory in operation, and there is no doubt but what it has helped materially towards increasing the popularity of the already popular electric vehicle. This is probably due to the fact that it makes possible for the electric vehicle owner to charge at home, which no matter how near by or well fitted a public garage may be is a great convenience.

For charging a number of automobiles in electric charging garages, the panel shown has been designed. While the exact method will differ with the conditions, the plan consists briefly in charging a number of vehicles connected in series multiple.

VEHICLE BATTERIES.[1]

BY GEORGE R. MURPHY.[2]

If a piece of copper and a piece of zinc are placed together so as not to touch each other, and immersed in dilute sulphuric acid in a cup, current will flow through a circuit connecting the copper to the zinc. This is one of the simplest forms of primary battery cells. The current is produced by the sulphating action of the sulphuric acid upon the metal. If by sending current through the circuit in the opposite direction, the plates could be restored to their original condition, this cell would become a secondary or storage battery. This particular restoration, however, is not possible and other materials have to be used.

In 1860, a Frenchman, Gaston Plante, found that a storage cell could be produced if the plates were both made of lead, one of them coated with peroxide of lead and the other with sponge lead. His method of producing the coating was by corroding the body of the lead plates by the action of the current, and by frequent reversals the coating becomes thicker and the capacity of the plates increased. In 1880, another Frenchman, Camile Faure, and an American, Charles F. Brush, almost simultaneously, made plates by applying oxides of lead in the form of a paste to the lead blanks or "grids." By a single long charge the plates could be immediately formed without the necessity of the deep corrosion necessary to obtain capacity from the Plante type of plates. In the course of time, both types of plates have been developed and improved, the Plante plates being made with corrugations, grooves, etc., to increase their surface, and a rapid electro-chemical process has been developed to shorten the time necessary to produce the requisite amount of corrosion on the surface of the lead.

The pasted type of plates has been refined by developing different mixtures of paste to regulate its porosity, and numerous forms of grids have been worked out with the idea of reducing the weight, resisting corrosion, and forming a durable positive support for holding and locking the paste or active material in its position. Plates of both the Plante and the pasted types are today extensively used, but, in general, plates of the Plante type are used for stationary batteries, such as in the regulation of power plants, whereas, in automobile work, the pasted type of plate is used almost exclusively.

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Engineer Electric Storage Battery Co.

The earliest commercial application of the storage battery for automobile propulsion was made in 1899, with a battery of modified Plante type, but it was not long before the makers of this battery—"The Chloride Accumulator"—foresaw the necessity of a battery for this purpose having more capacity and less weight and they started to develop one of the pasted type. This battery has become known as the "Exide" and is a development of the Bradbury-Stone type of grid. The earliest types of the Bradbury-Stone grids looked like a checker-board—the white squares of the checker-board representing one face of the plate and the red squares the other face. The two faces are united by ribs, or strips, running lengthwise, so that when the plate is pasted the paste is held in the grid in the form of a pencil between the vertical ribs and locked in place by the checker-board squares on each face. The whole grid was surrounded by a frame. This grid was heavy and a large portion of the surfaces of the active material was covered over and the next Bradbury-Stone improvement was in lightening the grid and exposing more of the surface of the active material. The checker-board squares have been much reduced in one dimension, bringing into prominence the longitudinal ribs and making the pencil of active material more pronounced.

The next development was in bringing the cross-bars on each side of the plate into alignment with each other while still maintaining the staggered relation with respect to the bars on the opposite face of the plate, and in further reducing the section of bars until the present type of plates were adopted.

The positive and negative grids are of the same design but the bars of the negative plate are lighter than those of the positive. The negative plate is also somewhat thinner than the positive.

In mounting the plates to form a cell, it is customary to use one more negative plate than there are positives so that both faces of each positive plate are active. The positive and negative plates are placed side by side alternately, with a space of about three-sixteenths of an inch between the faces of each positive and negative plate. Each plate is supplied with a neck or extension, called a "lug," at one upper corner and all the lugs of the positive plate are arranged to come out in alignment at one side of the jar and the negative lugs the other side. The plates are kept from touching each other by separators, placed in the spaces between the plates. The best material for separators has been found to be specially treated wood, which is grooved longitudinally on one side so as to give free circulation from the bottom to the top of cell. The flat side of the wood separator is placed next to the negative plate. The ribs of this wood separator in the standard assembly are not allowed to touch the positive plate since the highly oxidized surface of this plate has a tendency to char the wood if the latter is pressed up against it. There is, therefore, placed between the ribbed side of the wood separator and the positive plate a thin sheet of perforated hard rubber. This sheet of rubber is so very thin and contains so many perforations that the action of the electrolyte upon the plate is very little obstructed, and this rubber sheet in addition to the function already noted, is advantageous in preventing the washing out of the paste from the positive plate.

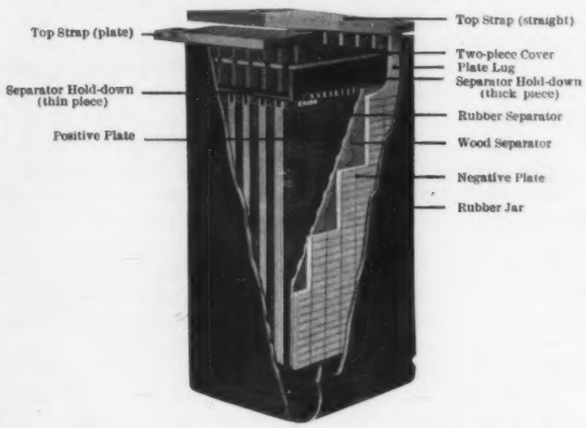
The positive plate lugs are all united together, as are also all the negative plate lugs, in each cell by straps, which consist of flat strips of lead or lead alloy having rectangular openings which are spaced to register with the lugs. The straps are furnished with projections which form the connections for the cells and are of three general types. The "L" strap is of the low-burned type, so called because the burning is below the level of the top of the jar, the post of the strap extending above the top of the jar. Where covers are used with this type the cover rests on the top of the strap and below the top of the jar.

The top straps are of the high-burned type, so called because the plate lugs extend above the top of the jar, the strap for the positives of one cell being in one piece with the strap of the negative plates of the adjoining cell, the strap itself thus making the connection from cell to cell. When the cells are arranged side by side the straight strap is used, and when arranged end to end the plate strap is used. When the covers are used with this

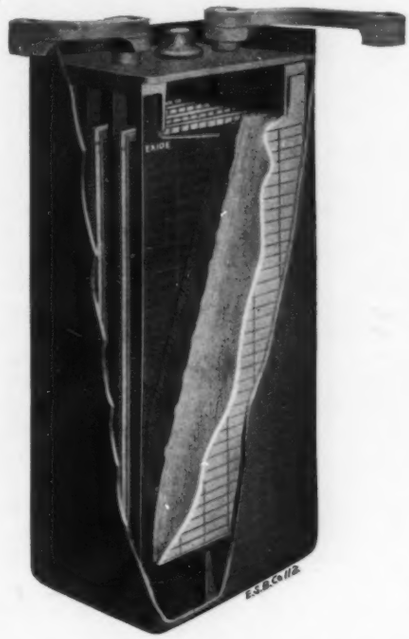
type of strap they are slotted to fit the plate lugs and rest in auxilliary supports placed on top of the plates.

The pillar type of strap is of the low-burned type, and the cells are connected by links burned to the neck or pillar, forming a part of the strap. The aprons extending from the lower side of the strap are to keep the wood separators from floating, which they sometimes have a tendency to do, especially when the cell is subjected to the violent vibration and jarring encountered in automobile service.

The accompanying illustration show two cells, one of which is assembled with pillar straps and the other with top straps. In the latter cell, the arrangement for holding the separators in place and supporting the cover is clearly shown, and in both cells, the arrangement of all the parts with respect to each other can be readily followed, by reason of the parts being broken away to show how they go together.



Cell Equipped With Top or High-Burned Straps.



Cell Assembled With Pillar Straps.

In mounting cells for the propulsion of automobiles, the necessary number to constitute one group are placed in a tray. The pillar strap is mostly used for cells of the smaller sizes, up to 35 amperes for four hours and the top strap is mostly used for cells of larger size, or in other words, the pillar strap is mostly used in pleasure vehicles or light commercial delivery wagons, and the top strap in heavy commercial vehicles. In commercial vehicle service covers for the cells are often dispensed with, as the batteries are usually worked more constantly and require more frequent inspection. For pleasure vehicles it is usually desirable to provide covers sealed in place, and the pillar strap is a little better adapted for this than is the top or the "L" strap.

Batteries for automobile work are rated at their 4 hour discharge rate. For instance, the 9 P. V. cell is rated at 24 amperes for 4 hours, the 11 M. V., 35 amperes for 4 hours. It is necessary to qualify the capacity of a cell by the rate at which the discharge is taken, since the capacity varies with the rates. A 11 M.V. cell can be called a 140 ampere hour cell, or a 161 ampere hour cell, according to whether it were rated at its 4 hour discharge capacity or its 8 hour discharge capacity. The Exide propulsion cells are rated at their 4 hour basis because that is the rate usually averaged under service conditions on the vehicle. The lower the rate of current the higher the capacity and conversely, the higher the rate of current the lower the capacity in ampere hours. At the lower rates of current the average voltage obtained during the discharge is higher, so that the watt hour output at the different rates varies even more than does the ampere hour capacity. This point is of the utmost importance in showing the necessity of keeping the automobile in the best possible condition so that it will consume the lowest possible current. If, by reason of poorly lubricated bearings or a binding brake, the current consumption of the vehicle is increased, the capacity of the battery, or in other words, the mileage which the vehicle can make is reduced in much greater percentage than that by which the current is increased. In many cases, the mileage is still further reduced by the characteristic curve of the motor, whose maximum efficiency is probably somewhere near its normal operating current, and may fall off quite considerably as the current is increased. The final voltage to which a battery can be safely discharged varies with the rate of current. The voltage during discharge is higher at the beginning and lower at the end and falls quite rapidly towards the completion of the discharge. If discharge were at the 4 hour rate the voltage at the start would be somewhat over 2 volts and at the completion would be about 1¾ volts. If the discharge current were at a lower rate the voltage would be higher throughout the entire discharge, and conversely. If the discharge current were irregular the voltage would be irregular and unless the current value and the voltage of this particular current were known it would be extremely difficult to determine from the voltage the extent to which the battery had been discharged. There is, however, an additional check upon the capacity of the battery due to the change in the specific gravity of the electrolyte. If, when the battery is fully charged, the electrolyte has a specific gravity of 1.28 it will drop to about 1.17 after its 4 hour capacity has been taken out. This drop in specific gravity is a straight line at a uniform rate. A given drop in acid density will correspond to a given number of ampere hours of discharge, irrespective of the rate of current. For this reason, the specific gravity is a much more reliable indication of the condition of charge or discharge, than is the voltage at any given time. In charging at constant current the voltage scarcely rises for a considerable period toward the beginning of the charge, after which the rise is gradual and towards the end becomes more sudden till it reaches its maximum point when it becomes constant. The specific gravity rise through the greater part of the entire charge is uniform but tapers off more gradually as it reaches its maximum value.

It is always necessary to put into a storage battery more ampere hours than have been taken out of it in order to fully charge it. The ampere hours which are lost are used up in forming gas—free oxygen being given off from the positive plates and free hydrogen from the negative plates. The amount of gas lost is greater with high charging current than with the lower rates. This gassing is to be minimized as much as possible not only on account of the loss in efficiency but also because the free gas being liberated causes circulating currents in the electrolyte which tend to wash out the active material from the plates. If there were no gassing until the cells became fully charged, then, at

a constant current the acid density would rise uniformly throughout the entire charge until it reached its maximum and would then hold this maximum, forming a sharp point in the curve.

Under proper service conditions the capacity of an Exide cell will increase with use. The Exide cell is rated at its initial capacity and as the cell is worked this capacity begins to increase until the cell which at first had a capacity of 4 hours may have a capacity of from 4½ to 5 hours at the same rate of current. This is due largely to the action of the active material on the positive plates, which, with working, becomes more porous and open at the surface. With use, however, this more porous surface material gradually becomes softer and the material nearest the surface, which is the softest, becomes washed out. After a time, a balance is arrived at when the increase of this capacity is neutralized by the loss of material and at this period, the capacity remains constant at its maximum value. In a short time however, the washing out effect becomes greater than the effect due to the opening up of the material and the capacity gradually falls off. The falling off, however, is much more gradual than the rise, until the material is very much washed out, when the plate is rapidly nearing the completion of its useful life.

The rise in capacity at the beginning is quite rapid and becomes less rapid as the life progresses. If the life had been started sooner, the gain in *life* would be very little, whereas, the loss in capacity would be comparatively very great. If, however, the life were started at the point of maximum capacity, although the initial capacity would be considerably higher, yet the amount of life lost would be considerable. There is thus shown a reason for rating the Exide cell on its present conservative basis. Very often other types of batteries have been rated at their maximum capacity, and in making comparative tests of different makes of batteries, the capacity characteristic during the life should receive very careful consideration.

There is often some doubt in the minds of the battery operators as to when a plate should be thrown away as worn out. If the thin portion is entirely washed out in any place, the general rule may be applied that the life remaining in the plate is not enough to warrant the expense of reinstalling the same positives. If, however, the washed out portions on either side of the plate do not meet so that there is a solid film of active material all over the plate, then, in general, the amount of life left in the plate will pay for putting it back into service.

It is difficult to express the life of a positive plate in any general terms; but, under any definite conditions of service, the life is, practically proportioned to the number of charges which the plates receive, but the life in actual number of charges varies with different users—some users getting over 350 charges, others not much more than 200.

It is very important that the battery be cleaned and all the sediment be removed from the bottom of the cells before it reaches the plates. Once the sediment reaches the plates, there is a discharge of wasted current through it, which necessitates more charging in order to obtain satisfactory capacity. This extra charging throws down more sediment. In addition, the sediment becomes sulphated and by local action with the active material of the plates in contact with it, causes the active material to become sulphated; this again furthers the tendency to increased washing out. The net result is that the plates begin to wash out much more rapidly if the sediment is allowed to deposit up to the top of the ribs in a jar. It is an excellent plan after a battery has been charged a certain number of times to cut out an element to determine the rate at which the sediment is being thrown down and to use the rate so obtained to determine a time at which it would be advisable to clean the battery and not wait until the battery shows some positive indications of need of cleaning before giving it attention. For example, if we take the case of a jar having ribs in the bottom 1¾ inches high and use the figures already assumed for the cleaning periods, we will, say after the battery has been in service for 50 discharges, cut out an element and find it has deposited ¾ inch of sediment in the bottom of the jar. We do not want to allow the sediment to get 1¾ inches deep and we therefore decided that the battery shall be cleaned when the sediment reaches 1½ inches. Since after finding ¾-inch sediment in 50 discharges, we will assume that it will take another 50 discharges to deposit the additional ¾ inch and so we decide to clean this battery after it has been charged 100 times. If under the same conditions we found that 1 inch of sediment had been deposited, we would decide to clean the battery after it has been discharged a total of 75 times. Operating under these conditions, we are pretty well assured of being able to keep ahead of the sediment. It is always advisable to make an allowance such as the ¼ inch assumed in the foregoing example, as there is apt to be some little variation in different cells and without cutting every cell apart, it would be impossible to determine the exact condition of every cell. The sediment will also deposit more rapidly during the latter part of a period than at the beginning.

The desirability is often expressed of having a battery possessed of greater capacity, for unit of weight, than that of the standard Exide. Probably the simplest way of increasing the capacity is to fill the plates with a more porous active material. This gives a greater active surface to the plate and consequently greater capacity. A plate of this kind, however, rapidly loses its active material, since, as can be readily understood, it is less coherent and will soften up much more rapidly than dense material. A better method of increasing the surface is to make the plates thinner and use more of them. In this way, we are able to obtain increased surface while still maintaining a dense and coherent active material. A thinner plate, however, will not have as great a life, expressed in discharges, as one of standard thickness, as there is less thickness of material for the washing out process to work on. The capacity on each discharge, however, for the complete cell is greater with the thin plates and although the life in discharges is shorter, yet the life expressed in ampere hours or in other words, the total mileage obtained would be about the same as that of a standard cell of the same weight if the full capacity were taken from the thin plates on every discharge. If a standard jar were filled with plates of one-half of the standard thickness and we should use twice the number of plates, the weight of the cell would be about the same. Although there are twice as many plates and twice the apparent surface, the capacity would not be twice that of the standard cell, because the thin plates do not contain twice as much material as the standard plates. A plate of one-half the thickness will not have the same capacity as a plate of standard thickness, but it will have *more than half* the capacity, and it is for this reason that the thin plate cell will have the higher capacity.

The Sparking battery uses plates of the standard Exide type though of special height. These plates have given excellent results in this kind of service. A practical sparking battery should not only contain good plates, but even the best plates are not serviceable unless they are mounted in a manner which will insure satisfactory results under the conditions to which such batteries are exposed. It is especially necessary that all parts should be hermetically sealed to prevent splashing of the electrolyte and consequent corrosion of the wires and terminals and other damage. The parts must be rigidly mounted or the connection will not be maintained under the severe conditions of vibration and knocking around which these batteries receive. These batteries usually consist of three cells mounted as one unit in a wooden box by imbedding the jars in compound which is poured into the box around them. The elements are mounted with wooden separators, covers and pillar straps. The covers are sealed and the compound is flooded over the entire top level with the top of the case to the pillar strap of the positive group of one of the end cells and to that of the negative group of the other end cell are burned extension terminal lugs which come up out of the compound for the attachment of the connector bolts. Beneath the compound, the terminals have a flange to anchor them in place and prevents creeping of the electrolyte at this point. The cover of each cell is fitted with a hard rubber tube extending through the compound, through which the cells can be inspected and the electrolyte kept to its proper height. These tubes are

closed by a special vent cap, which, although it allows the free escape of the gas, is designed to catch any splash or spray and return it to the cell. This is accomplished by providing the cap with a downwardly extending cone in the upper part of which are holes to allow the escape of gas, while in the apex is a hole to allow the return of the liquid. The case is provided at either end with buttons to which are attached a strap of rubber fabric for lifting and carrying the battery.

In manufacturing storage batteries, it is necessary not only to produce the best material possible, but to make every cell and every plate and part uniformly good. It is not only necessary that the material should be of proper purity and be properly put together, but in order to obtain the best results, it is necessary that the user be just as careful to properly install and operate his batteries. Upon receipt of the material it should be examined for breakage and foreign matter, and should then be erected in accordance with the instructions which are sent with each battery. In order to start the battery off properly, it should be filled with electrolyte of the proper specific gravity and the initial charge given until the battery is fully charged. The initial charge requires to be of a capacity several times that of the ordinary discharge capacity, as, without this, the plates cannot be brought up to a state of complete charge. If they are not brought up on the initial charge, the probabilities are that they will never be fully charged, and a certain amount of sulphate will remain in the plates which will produce local action and materially shorten their life.

In regular operation it is best to charge at the lowest rate possible. As already pointed out, the principal wear on the plate is caused by the gassing during the charge. As this gassing is reduced by a lower rate of current, the wear on the plates is correspondingly reduced. Since the gassing occurs most towards the completion of the charge it is at this point that it is most imperative to have the current low. The rate of charge is usually limited by the available time and in order to get the necessary number of ampere hours, into a battery in a given time with the least wear, the current should be high at the beginning of the charge and low at the completion.

There is very little affect of current rate in discharge upon the life of Exide cells. In discharging at a high rate, less capacity is obtained that if discharged at a low rate, expressed in ampere hours. The effect of discharging at a high rate is, therefore, somewhat similar to a partial discharge at a low rate.

It is a fortunate thing that batteries give best results when operated at temperatures most comfortable to human beings. There is no particular harm done to a battery by extremely low temperatures although the capacity is reduced as the temperature is lowered. The effect of lowering the temperature is much the same as that of increasing the discharge current, both the capacity and voltage being lowered. As the temperature is increased above the normal, however, the capacity is increased but the tendency to sulphate and to injury by local action becomes greater. High temperature has much the same effect on a battery as that of increasing the specific gravity of the electrolyte. If the electrolyte is weakened, there is, unless the specific gravity is very low, little serious damage done, the capacity merely being reduced. If, however, the electrolyte be too strong there is an increase of capacity, but also an increase in local action and a tendency to sulphate. The same effects are produced by high temperature.

There is often much more strong electrolyte in the cell than is shown by the hydrometer readings. Such a condition exists when a battery has not been sufficiently charged, either at the beginning of its life or at subsequent periods. There is a resulting accumulation of sulphate in the plates which causes a gradual reduction in the specific gravity of the electrolyte. The cause not being understood, the gravity is brought up by the addition of a stronger solution and thus the trouble is further aggravated until, finally, a marked deficiency in capacity causes complaint. Batteries in this condition require a very long time of continual charging to reduce all the sulphate, and this time is required even though a high current rate be used. There are two reasons for keeping the current low under these conditions. In the first place, the time for bringing the battery into shape cannot be reduced and a large proportion of the current is wasted, in addition to which, there is an unnecessary wear on the plates. Badly sulphated batteries, although their voltage on charge may be high, do not show increase in specific gravity until they have been charged for several hours. As the gravity begins to come up, there is also an increase in the voltage due to increasing the conductivity of the plates, since sulphate is a poor conductor. It is not until the specific gravity and the voltage have reached a maximum point, determined by taking several successive readings at intervals, that the battery can be considered brought back to its proper condition. The abnormally high voltage reading at the beginning of the process is due to resistance but at the completion, the voltage rise is due to counter E. M. F.

It is rarely necessary to add anything but water to the cells between the time of cleaning and it is usually in cases where there is much splashing or where there are leaks in the cells that acid has to be added. Although the sediment, by sulphating, absorbs some acid, this is not enough to make more than a few points difference in the specific gravity.

For propulsion batteries, a specific gravity of between 1.27 and 1.28 is recommended when the batteries are fully charged. Before the battery is assembled, the plates are in a somewhat sulphated condition and it is therefore necessary to fill them initially with electrolyte with a low specific gravity. Where wood separators are used, this electrolyte is 1.20, and where all rubber eparators are used, it is 1.16. In no case should electrolyte be allowed to become higher than 1.30 when the cell is in a state of *full* charge and the plates are absolutely free from sulphate.

The instruction books furnished by The Electric Storage Battery Company have been revised from time to time, and the Exide book is now in its sixteenth edition. Boiled down, the most important rules to be followed are as follows:

1. Keep the electrolyte above the top of the plates.

2. Do not allow the batteries to remain an unnecessary moment in a discharged condition and at intervals see that the battery is charged to its maximum.

3. Never replace evaporation with any thing but pure water.

4. Do not make a practice of charging batteries when only a small percentage of their capacity has been taken out. This rule, however, may be modified in the case of batteries standing with little or no work, in which case, they should be freshened by charging from time to time to prevent their sulphation from local action.

Creosote treatment of loblolly pine telephone poles has been so successful that the Louisiana Creosoting Company has been formed to operate commercially the plant designed by the Forest Service. The treating plant, which has been in operation since the latter part of October last, is of the "non-pressure," or "open tank" type. The installment of this type of plant costs much less than a plant of the "pressure" type, which is the ordinary type of plant for commercial purposes throughout the country. The "open tank" system depends fundamentally upon the immersion of timber first in a hot bath of the preservative, followed by a rapid change to a cold bath. This method does away with the installment of high pressure and vacuum pumps and a treating cylinder of massive construction to withstand a high internal pressure, which are necessitated by a plant of the pressure type. It is usual, however, to install a treating cylinder of light construction where any great quantity of material is to be treated, since the cost of handling the material and loss of preservative through volatilization during the hot bath is in this way reduced to a minimum. Extensive experiments carried on by the Forest Service in recent years, have shown that the "open tank" system is admirably adapted to the treatment of certain classes of timber, and especially so as regards loblolly pine.

RELATION OF CENTRAL STATIONS TO THE AUTOMOBILE BUSINESS.[1]

BY FRED T. KITT.[2]

We are all more or less familiar with the central station term "peak," which denotes the time of maximum demand upon the station for power. Ordinarily, the daily load curve of the central station approaches the peak in the early evening and usually continues but a comparatively short time.

One of the big problems, the satisfactory solution of which spells success for the central station, is the question of "peak load." It is obvious that sufficient capacity in generating machinery, prime movers, distributing copper and auxiliary apparatus must be provided to meet this maximum demand without regard to what the ordinary demand may be.

A central station which is able to so dispose of its energy that the peak load is low, compared to the continuous load, can afford to sell its products at a much lower rate than the price which must be asked by the station that has a high peak.

The occurrence of a peak may be avoided to some extent by encouraging long hour customers, by dividing the load between the customers using power at different times of the day, and by storing energy during the hours when the rates of consumption of energy is low.

Since the electric motor has come into such popular favor, the method of dividing the load between power users which consume during the day, and lighting customers which demand power only at night, has become almost automatic. No matter how much power load is developed, however, the peak is always noticeable. Even if the power load should exactly equal the lighting load and the time of dropping off the one would coincide with the taking on of the other, an ideal condition which could never be realized in practice, the only result would be to flatten the peak, or in other words, the peak would come on as the power load came on in the morning and continue until the lighting customers began to discontinue their lights at night. While this would be considered a very good load and power could be sold at a very low rate, still much of the apparatus of the station and distributing system would be idle from a comparatively early hour in the evening to the following morning. As interest charges, depreciation and other expenses come on night and day, it is desirable to keep all the equipment earning something for the full twenty-four hours.

The best solution then seems to be a combination of these methods. Storing electrical energy is best accomplished by means of the storage battery, although other systems have been proposed, such as pumping water from a low to a high level during hours of light load and allowing it to fall upon water wheels during hours of heavy or peak load.

On this coast where a great part of the energy is produced by water power, the question of securing load after the evening peak is even of more importance than where fuel is used. When the peak is off in a steam plant the fuel consumption is also less, while in a water power plant water usually goes to waste when the load drops off.

With our modern system of alternating current distribution, storing energy by means of the storage battery requires not only the battery but the converting and auxiliary apparatus as well.

Electric vehicle batteries are nearly always charged late at night, and as the customer owns his own battery and converting apparatus and uses power at a time when both the motor consumer and the lighting customer have gone off the line, they are the most desirable customers.

Many of the central stations do not as yet make a sufficiently low rate for this class of business, which fact must be due to their not having considered the question carefully, and I think most of them could be brought to see the advantage of selling energy off the peak to be used for pleasure vehicles, delivery wagons and trucks during the day, and would make a rate low enough to encourage the adoption of electrically propelled vehicles to such an extent that their revenue would be materially increased.

It is certainly gratifying to those interested in the electric automobile business, to know that their goods have been so perfected that they are now becoming an actual necessity, not only for the purpose of passenger transportation but also for transporting freight on the streets of our cities.

The electric pleasure vehicle has already displaced thousands of horses and the modern electric truck is now coming in favor so fast that it will not be long until horse drawn vehicles will be the exception, and when we see the thousands of horses still plodding along our streets we can see the tremenduous demand there will be for the product of the central station when these changes are made. It is also pleasing to us to know that the central station people are beginning to realize the great opportunity that the electric vehicle business has to offer them and that they are fast becoming convinced that a little effort spent in encouraging the use of such vehicles will be handsomely repaid by a permanent and desirable load connected to their mains, the securing of which requires practically no extra investment on account of the fact that practically all the energy used for charging vehicle batteries is used when the load on a station is light and the station apparatus would otherwise be idle.

Many central stations are spending thousands of dollars for maximum demand indicators and other devices, and are using complicated systems of accounting to improve their load factor that are now finding out that the electric vehicle in combination with other motors are solving the problem automatically. One customer may have a high maximum demand on a lighting load, another on a power load, another on a vehicle battery. The resultant of all these tend, not only to keep down sharp peaks in the load curve, but, on account of this improvement of the load factor, the station may make a lower rate on all of its energy, thus encouraging greater consumption and receiving a larger income.

The central station people in looking back over their experiences can see where the popular use of the electric motor has enabled them to reduce the price of energy in general, and I am sure none of them regret the encouragement they offered to the power business at a time when it was not so well developed as it now is, for it has built up for them a day load which keeps the station and distributing apparatus earning something during the day as well as during the evening. And now comes the electric vehicle. During the day when the station is supplying energy for industrial purposes, and during the evening when its products are being used for lighting, the electric vehicle is busy using up energy stored the night before and is willing to wait until the lighting customers are satisfied before again making any demand on the central station.

For this reason the central station should make a very low rate for vehicle battery charging, as it is by far the most desirable business that can be secured. In cases where there would be a possibility of the charging being done over the peak, a clause could be inserted in the contract whereby a penalty would be attached for using power during certain hours, which could be made large enough so that no customer could afford to take the risk of being caught violating this contract.

I understand that nearly all of the Edison companies and many other Eastern companies are pushing the vehicle business to the front. Many of them have large garages for the care of their own machines and have discarded horse drawn vehicles entirely, doing their heavy trucking as well as making their business calls by the use of electrics. In this way they not only set an example to the public but find that they save money, aside from the advertising feature which is secured by the use of such up-to-date business methods.

The operation of a modern central station in connection with its necessary distributing business requires many vehicles of different classes, from the light runabout to the 5-ton truck, and the central station should be the first to discard horses and thus hasten the day when electricity will be the only source of power used for all city transportation.

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Sacramento.

THE ELECTRIC VEHICLE MOTOR.[1]

BY J. T. DEREMER.[2]

We have all, I am sure, listened with interest to the excellent and instructive papers which have been read here today, and we have also learned much from the many points of view brought out in the various and able discussions which have followed these papers. So clear and evident have been these arguments made during the course of the day's progress that we have doubtless each firmly resolved to immediately begin the manufacture of mercury arc rectifiers and storage batteries, or at once promote a central station industry.

And so, I shall feel only complimented, if, by inflicting upon you here at the close of the day this seemingly technical paper on the electric vehicle motor—the last link to be put into our equipment—the one which produces *motion*—can I feel other than complimented if I now succeed in creating within you a desire for motion, which desire shall move you all from the room perhaps before I have finished.

However, I shall proceed with my paper hoping that the desire to follow our machine through to a completion will concentrate sufficient attention to the points which I wish to lay before you. For surely the vehicle without its motor is far from complete.

The motor equipment of an electric vehicle consists of the following:

One—One or two motors, according to the requirements of the vehicle.

Two—The controller complete with cable tips.

Three—The main switch with cable terminals.

Four—The charging receptacle with plug and cable.

Five—The battery contacts with cable terminals.

Six—The wire and necessary wiring diagrams.

With these parts properly selected, any one familiar with ordinary vehicle construction can build electric vehicles also.

Of these parts we shall here consider only the motor, its controller, and their connection to each other.

Let us first look into the advantage inherent in an electric motor for this use. As has been said earlier in the day the electric vehicle is not in its present stage of development adaptable to all purposes for which other types of cars have proven so successful, but in its own particular field of operation, namely, the city suburban duty, it has advantages over all others, and of these advantages the following stand out conspicuously as due to the motor.

Its operation is noiseless; due to the absence of reciprocating parts, it is free from vibration—it is cleanly and free from odor—it is very simple in construction and suspension, thus permitting of easy and rapid repairs or replacement, and its maintenance and up-keep are comparatively negligible. Other distinct advantages will be brought out during the course of the description of the motor construction.

Before going into an analytical study of the motor, let us for a moment look into the requirements of a vehicle motor.

The motor best suited to this service combines those features which will give sufficient strength, together with the best average speed, efficiency and high torque values in proportion to the current consumed. Unlike motors for all other classes of work, it can have no protective devices, such as circuit breakers, or wires that will fuse and open the circuit when an excess of current passes. Such protection is impracticable, because when an excessive demand for power is made by the motor of an electric vehicle it is at a critical point in its operation, as on a heavy grade, a bad place to start, or a condition when above all other times power is wanted most and must be relied upon. The motor, therefore, must be designed and constructed to withstand all the power that can be applied to it in the propulsion of the vehicle for which it is built. Further, automobiles are frequently driven by persons who have but little idea of what a machine should be able to stand, and who, therefore, use poor judgement in operating them. Motors which cannot undergo the abuses of such service without injury are not practicable. In still another respect an automobile motor must possess exceptional qualities—it must combine strength and lightness, so as to insure good operation amid all the jolting and vibration of travel, with the fewest possible repairs. A properly designed motor, for use in connection with storage batteries, must possess a well sustained efficiency curve at overloads, and still retain its good speed and torque characteristics, throughout its range of operation. The amount of iron and copper used must not be stinted, although generous proportions in this respect may add somewhat to the weight of the motor, this increase is more than counterbalanced by the resulting improvement in its operating characteristics.

Let us now look briefly into the construction of the motor, to see how the above requirements have been fulfilled.

The motor is built for two sets of speeds: the high speed motor for operation with a double reduction gear and the low speed motor with a single reduction gear. Where large output together with light weight are the essential requirements, the light weight, high speed motor, with the double reduction gear is preferable. On the other hand, where a greater weight is permissible and long life of wearing parts is a feature, the heavier weight low speed motor, with the single reduction gear should be used.

We shall treat the construction of the motor under two heads:

The Mechanical Construction.

The frame of the motor is built in cylindrical form. This is in order to get the greatest output from the least quantity of material. The frame is entirely enclosed and solid, that is, made in one piece. The armature is removed by taking off one of the end brackets. The motor is made waterproof, which is a valuable feature when the madam's garden hose is turned on the machine to remove the mud accumulated during the recent rain. The armature and commutator of the motor are built up on one sleeve, and the shaft pressed into this sleeve, so that if the shaft of the motor becomes sprung through careless operation or very rough usage, the same can be readily removed and another put in.

The oiling system is the same as employed in street railway motors, that is, the well known type of wiper or waste packed bearings. The motor is suspended by four stud bolts at each end and is thus easily removable for replacement or repairs when necessary.

The Electrical Feature.

The automobile motor is of the direct current series type, and has operating characteristics similar to the well known street car motor. Other types have been tried, such as compound wound motors and also shunt wound motors, but none of these possess in the same degree the valuable characteristic of automatically adjusting the consumption of power, as it were, to the load, that is, as the load increases the speed decreases, thus lengthening the time of operation and hence decreasing the power necessary to produce a definite torque. The efficiency of the motor is maintained fairly high throughout its range of operation.

Just here let me call your attention to a feature especially characteristic of the electric motor, as compared with other forms of vehicle motors.

As is well known, a railway type motor is rated intermittently, that is, the nominal capacity of the motor, is that capacity at which it can operate for one hour with a temperature rise not to exceed a given amount. This method of rating has been found best adapted to work, such as the operation of street railway cars requires, because on an average city line the motor is working only a few moments at a time, due to the many stops and inclines, and hence has an opportunity to cool down during the intervals when current is not applied.

Obviously, a motor suitable for continuous operation, developing the same horse power as a regular street car motor oper-

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Westinghouse Electric and Mfg. Co., San Francisco.

ating intermittently, would have to be very much more liberally rated in order that the heat generated internally could be radiated sufficiently fast to prevent an injurious rise of temperature.

Now the same principles apply to automobile operation. That is, a motor in city truck service, as well as pleasure vehicle operation, is subject to only intermittent operation, and consequently the motor can be rated much more closely than could a motor for continuous operation.

It has been found that for continuous operation, the demand on the motor must not exceed sixty per cent of the one hour rating. The point I wish to emphasize in this connection is as follows:

By reference to the performance curves of the series automobile motor, it is found that the efficiency of the motor is highest when operating at approximately 60 per cent of the nominal rating, hence, if continuous operation is necessary, the maximum permissible output which can be taken from the motor will be obtained with the motor operating at its highest efficiency. You can easily see that this is a very valuable feature.

The Controller.

Let us now take up the controller and its connection to the motor, in order that we may ultimately bring out other points of advantage in the complete electric equipment.

The controllers for vehicle motors are made in such a form that they may be set in the seat of the vehicle where they are easily accessible from the top and the front. The controller is of the familiar drum type, with sliding contacts and fingers which press against the contacts. The reverse drum is a part of the controller and is operated by the main control lever, or by a heel press at the bottom of the vehicle. The main drum and the reverse drum are made interlocking, so that it is impossible to reverse the motor with the controller handle in any but the off position. In this position the main drum is locked unless the reverse drum is exactly in the forward or reverse position.

The operation of the controller serves to apply several successive electro-motive forces to the brushes of the motor armature and hence vary the speeds accordingly.

The method of control differs somewhat from that employed in street car service, in that no resistance is employed for controlling the voltage applied to the motors. The interconnecting of batteries and field coils, and motors, is so arranged that four speeds forward and from one to four speeds reversed operation are obtainable.

This type for control for automobiles is of two kinds. First, that in which the battery connections are changed as well as the motor connections. This plan is employed usually where only one motor is used, or where it is essential to make the work required of the battery as easy as possible. The second type of control changes only the motor connections, the battery cells always remaining in series. This plan is employed where two motors are used, as it is here possible to obtain a greater number of combinations than in the case of a one motor equipment.

If you will bear in mind that the fields of each motor are separated into two equal groups, and that the battery is arranged into two equal groups of cells, the following brief statements of the motor control will be easily understood:

FIRST NOTCH—
Field groups in series.
Battery groups in parallel.
(This applies the lowest obtainable electro-motive force to the brushes.)

SECOND NOTCH—
Field groups in parallel.
Battery groups in parallel.
(This applies a higher electro-motive-force to the brushes, because the total voltage drop across the field is reduced.)

THIRD NOTCH—
Field groups in series.
Battery groups in series.
(This applies a still higher electro-motive-force to the brushes.)

FOURTH NOTCH—
Field groups in parallel.
Battery groups in series.
(This impresses the highest obtainable electro-motive force upon the brushes.)

In the two motor equipment the fields as before are in two groups, but the battery is always in one group. The connections are made here as follows:

FIRST NOTCH—
Field groups in series.
Armatures in series.

SECOND NOTCH—
Field groups in parallel.
Armatures in series.

THIRD NOTCH—
Field groups in series.
Armatures in parallel.

FOURTH NOTCH—
Field groups in parallel.
Armatures in parallel.

You will note in the above description of speed control, which possibly sounds somewhat complicated, and yet in reality is extremely simple, that there is an entire absence of mechanical complications such as is necessary in other types of cars, the motor being in every instance, connected rigidly to the driving wheels, and the entire control of the machine reduced to the simple electrical control of the motor. This fact brings to mind two very important advantages of the electric driven machine, namely, in addition to the regular band brake equipment of the automobile, an emergency brake can be arranged on the end of the motor shaft, and since the motor is always in direct communication with the driving wheels, this will prove an additional factor of safety. There is further a possibility of using the electric motor as a generator for braking purposes, thus eliminating brake friction and the strains incident to brake application. The motor is turned into a brake or generator by simply reversing its armature connections and connecting the armature leads across a resistance.

The above plan, however, is very sensitive to the speed at which the car is moving at the time the application is made, being very light at low speed and very heavy and effective at high speed. The better plan is to place the fields in series with each other and with a small hand operated resistance across a few cells of the battery. Then by closing the armature circuit the amount of braking effect can be regulated by the resistance handle, and the braking as in the case of a long hill made as effective as desired.

It is almost superfluous to add that the up-keep of the electric motor and controller is scarcely to be considered seriously. Of course, the bearings and brushes need occasional looking after, but as in street car service the brushes frequently run for months without renewal and bearings only need their proper supply of oil. The attention given any ordinary piece of machinery will, of course, keep the bolts tight and the lids and the hand-holes covered, which is more vital in the case of the motor, owing to the necessity of excluding of moisture. There must be an occasional renewal of pinions and bearings, but taking the subject as a whole the cost of maintenance of the electric motor equipment is very slight.

Summing up the situation then—as a power, the electric motor is incontestably a most suitable medium for automobile work, by reason of its being practically perfectly safe, its capacity for direct application, its high ratio of efficiency and the facility by which it can be controlled. Not only does the electric motor automatically control the consumption of energy, both with light and heavy loads, in proportion to the power delivered, but it will also work should occasion arise, with an overload of several hundred per cent for brief periods of time without any appreciable inconvenience.

THE ELECTRIC COMMERCIAL VEHICLE.[1]

BY A. C. DOWNING.[2]

The electric commercial vehicle, its development, field of action and sale is the direct subject of this article. But to place the matter clearly before you decided it advisable to discuss in a general way the whole field of commercial vehicles first, then specialize.

You as central station managers, superintendents, or automobile dealers, as the case may be, naturally are the best mediums through which results can be accomplished. The development of the field for electric machines is a point of vital interest to us all. Many never having had an opportunity to come in direct contact with any prospective purchasers will relate some of my experiences and arguments. In this way I believe you will be able to grasp the situation more readily and profit thereby. The discussion following the paper will enable you to ask such questions, or make suggestions as may arise in your minds.

Arrangements are made for demonstrations over the various routes and then comes the real struggle. All the drivers imagine their jobs are in jeopardy, besides the horses have become part of their lives, hence arise jealousies and skeptical opinions. Many of them are "kill joys" of the first water. In most every instance while your truck is waiting for a load there will be other drivers congregate and a conversation similar to the following takes place:

> "I'll bet you, Bill, she won't go my route. You get her out on West Seventy-second street, between Clark Brown, when I have that pound of tea for Mrs. Jones. Twenty to one I'd be phoning for them to send me 'Bess and Bill to the little red wagon.'"
>
> James cheerfully speaks up: "They 'ought to' send that 'ortermobile' on my Johnsville route, specially after a big rain. The odds are against her ever coming back," etc., etc.

One morning when demonstrating in Portland, while one of those mists that "don't wet you" "happened" to be falling, I was waiting in front of a residence on Willamette Heights when, presumably, the owner of the home and his wife came out to take a street car. In passing the wife said, "That is one of those little electrics. I do hope they will become more general in service as I hate to see the poor horses tire themselves out climbing these hills." Mr. Husband, with stern voice, said, "They are all right on the level but they won't last long on the hills," and with that stepped up closer to the machine and asked what make it was, and as to what experience I had had in negotiating the local hills. I replied the car was a Studebaker and that we had been doing excellent work over Willamette and Portland Heights, obtaining exceedingly good mileage. The wife spoke up saying she was glad to learn such was the case. The husband remarked to her, "Dear, the mileage of electrics will never hold up on hills as such a thing would be 'diametrically' opposed to the law of physics." Just at that moment the car came along. I have been looking for that man ever since to ask him if he remembered that it did not require any power when going down grade, also that by climbing hills on intermediate speed, the current consumption was some less than on high, thus gaining an efficient discharge from the battery.

Studebaker Electric Baggage Truck.

Transportation of merchandise is an expensive part of a business, especially in large cities where there is congested traffic and high labor. A solution will be the self-propelled vehicle, thus occupying less room in the streets, getting away from railroad sheds and docks in better time, and one commercial vehicle driver being able to move two tons in the same time necessary to move one ton with horses.

Street conditions play an important part in the successful operation of automobile trucks. Hence the more rapidly streets are improved, the quicker auto trucks will come into general use.

When approaching firms regarding making investigation and considering the use of commercial vehicles, I find the owners, or managers, are always willing to give the matter due consideration. The superintendent of the delivery system, and stable "boss" are called in to give such data as may be desired. They gladly enter into the spirit of the matter, appreciating fully the value of an up-to-date delivery system.

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Pacific Coast Sales Engineer Studebaker Automobile Co.

Limitations.

Generally speaking this is a world of limitation. Every day produces more specialties, each object having its own function to perform. The doctor actively engaged in his profession cannot practice law, the brewmaster cannot sell ribbons, the gas maker cannot produce chocolate creams, the watchmaker cannot install a 5,000 h. p. turbine and generator, hack saws won't do for the production of a masterpiece oil painting, a ferry boat cannot compete with the Lusitania on the seas. So it is with the self-propelled vehicle against that of the horse-drawn type, both have their limitations and adaptibilities to their particular type of service.

Conditions must be considered. In negotiating the mountain paths of South America how long would the large Percheron horse last as compared with their mountain burro? In Venice what chance would a team of horses have as compared to the gondola or what kind of a show would the little Jap with a jinrikisha have against the taxicab for service in New York City. Such comparisons have about as sensible a sound as have some of the arguments put up against the commercial vehicle.

Labor saving devices are sold only after the public have been educated. We can all remember our first visit to a store, one part equipped with a cash box carried on an overhead wire, and the other part where the poor saleslady was continually ruining her voice calling for "cash." Many other such comparisons can be made.

In one instance my patience was tried to the breaking point, as one of the delivery boys was talking so boisterously, and boastingly, against the machine. I called the manager of the delivery system and asked him to give me that boy's route the next day. He did and naturally the boy hunted all the bad places possible. In spite of them we covered the route in exactly half the time usually consumed with his horses, and as a consequence the young man had to make another trip the same morning. Afterwards when the automobile delivery wagon drove up he was the first around and more than interested in how everything was going. He called me to one side saying, "I wish you would speak to the boss about me if they buy any of these machines, as I would like to drive one." This story is an illustration of what obstacles have to be overcome.

Types of Self-Propelled Commercial Vehicles.

Steam, gasoline and electricity are the most used sources of power. The steam type has not been developed to the extent in this country that it has in Germany and England. At the New York Automobile show just closed there were twenty-two concerns represented as manufacturing the electric and gasoline commercial vehicles. This will give the layman a fair idea as to the magnitude of the business.

Electric trucks have been successfully operated longer than any other type. At present there are many machines five and six years old giving as good service as when first installed. The Weidemann Brewing Company of Cincinnati, Ohio, which is a very hilly city, have six electric machines that have been in operation since 1903. Today they are giving the same service as when new.

The Anheuser-Busch Brewing Association have had fifteen of the three and five ton capacity electric trucks in operation since 1903. The depreciation on them has been very small. At present their commercial department consists of fifty-six electric trucks, varying from one and one-half tons to five tons capacity, and four machines of the gasoline type for extremely long runs.

The Adams Express Company have been, and are using electrically propelled vehicles exclusively in Washington, D. C.; Indianapolis and New Haven, Conn. They are using partial equipment in New York City, Chicago, Philadelphia and Rochester, New York.

The American Express Company are also using them in most of the largest Eastern cities.

The Los Angeles and Redondo Electric Railway Company are operating some fifteen electric trucks in Los Angeles. These vehicles represent practically all the heavy commercial vehicles used in any quantity by one concern on the Pacific Coast.

There are, of course, numerous gasoline light delivery wagons of 100 or 200 pounds capacity but are really pleasure vehicles with commercial bodies, so cannot be counted in the commercial vehicle class.

The above concerns represent classes of business having large delivery systems that must be in operation every day. They are conservative firms and have made extensive tests, minute investigation, only purchasing electrics after having been convinced of their reliability.

Failures.

There are always two sides to any question. There have been failures with electric vehicles—not so much failure of the machine, but owing to the lack of proper attention, and intelligent application. Trucks not being properly applied, and men in charge and operators not having had sufficient instructions as to care and operation from the makers. Often a five ton truck has been sold where the load occasionally amounted to that much. The three ton vehicle would have worked more successfully, making better time and entailing a smaller investment, and a much less cost of upkeep. Manufacturers in many instances have been responsible for such failures and mistakes. In several instances on the Coast the cars were sold, money paid, the representative left for the East immediately, and all responsibility shifted. Such practices have discredited the business, making it hard for a firm with good intentions to live it down.

Another tributary feature to the failure has been a mistaken idea many have had regarding giving automobiles attention. No piece of machinery is called upon to do so much work, with so little attention, as the automobile. This has been particularly true with commercial vehicles. I have known personally, in three instances, of an automobile truck running for five months without the wheel bearings even looked at. Would anyone treat a horse-drawn wagon in that way? The best part of it was the bearings were not injured; thus clearly demonstrating life a self-propelled vehicle would have, if given proper attention.

Application.

For long distance or interurban work the gasoline machine would be the most suitable. For city and surburban purposes the electric will prove more economical and satisfactory. Following are a number of reasons for my making this last statement:

First:—Their speed is within the scope of the law and the bounds of safety. A loaded car propelled at too high rate of speed is a menace to public safety.

Second:—If heavy loads are carried at greater speed than seven to twelve miles per hour, over the ordinary street one finds in the wholesale and shipping districts of a city, the strain and shocks on the wearing parts will incur more cost of upkeep than will be saved by quicker delivery. Engineers' tests have often proven this.

Third:—Being free from so many small mechanical moving parts insures reliability.

Fourth:—Simplicity of control permits an electric truck being handled successfully by regular horse drivers.

Fifth:—The motors employed are of the series type, like those of the street car. They are built to stand extreme overloads for an instant. Most everyone knows electric motors have long life entailing very small cost of upkeep.

Sixth:—The storage battery in its present stage of development represents a certain number of cycles (that is charges and discharges), thus making it possible to figure, with a degree of accuracy, the number of miles obtainable during the life of the plates. With this data at hand the cost of operation can be easily determined.

Seventh:—Continuous torque controllers eliminates all chances for arcing and "freezing." It is very seldom any trouble arises from the controller outside of the ordinary wear and tear.

Eighth:—Batteries and motors being hung underneath the framework, permits any body design desired. Also permits equal distribution of load over the rear and front wheels.

Ninth:—This equal distribution of weight saves tire expense, particularly on the rear wheels where the tires have to withstand the tractive friction, as well as the weight of the load.

Tenth:—Accessibility to all parts means simplicity in repairing and garage care. For instance if the crank shaft bearing of a gasoline truck should burn or wear out, the replacing of that bearing within itself does not consume one-fifth the time that is required to dismantle an engine and re-assemble. Putting in an engine for immediate service cannot be considered on account of the many connections to the carburetor, pump, radiator, fan, gasoline tank, exhaust pipe, magneto, batteries, transmission, and truing up in proper position on the frame. The same would be more or less true in event the transmission, or differential, were injured.

On the other hand with an electric truck the controller is independent mechanically of any other part. By loosening the wire terminals it can be removed and another one replaced easily within an hour. In five years association with electric commercial vehicles I have never found it necessary to pull out a controller provided the machines have had any kind of treatment whatsoever.

Batteries can be exchanged by two men in fifteen minutes.

Should an armature need attention, or become necessary to replace the motor complete, the change can be made within an hour and a half. Of course the repairing of axle, bearings, frame, body, or wheel, would remain constant with either gasoline or electric vehicles.

Summing up this tenth item means an equipment of say ten gasoline machines would require two or three extra machines to keep up the daily service, while one extra will do for an equipment of thirty electric machines. This point is not a guess or theory but a statement of results after quite a few years of actual work with machines in various classes of service in widely different cities.

Eleventh:—The keeping of electric machines in any building does not affect insurance but gasoline trucks will raise the rate to a point almost prohibitive.

Twelfth:—In a private garage where a number of gasoline trucks are cared for, every man must be a high grade mechanic, outside of washers and day laborers.

When caring for electric trucks, so much high grade help is not necessary. One each, experienced, well posted battery and motor man can successfully handle several trucks. If additional help is desired most anyone can wash, clean and reburn batteries, with very little experience. The motors and electrical parts have never caused enough work, in installations even the size of Anheuser-Busch, to keep one electrician busy all the time.

General Tendencies.

The improved streets and increasing size of cities are working greater hardships on the horses. In the wholesale districts just watch the poor beasts trudging along doing their very best for the master, but what is the result? The hard surfaced road stoves him up, the rains, snow and heat all produce ill results. These points are not drummed-up fancies—just read what active steps are taken by the humane societies. Very rigid laws are outlined and enforced. The maintenance and enforcement of such laws cost the cities dollars each year.

With the automobile, the hard surfaced streets exactly fill the bill. The elements don't affect them in any way, and who cares if a piece of machinery is abused, outside of the owner.

The sanitary features are worthy of mention. The cost of cleaning the streets of New York City is much less particularly around the hack stands and vehicle waiting lines in the shopping districts.

With the saving of time and labor which really is money, the electric commercial automobile will become more commonly used, but this time can be hastened if those interested in electricity will inform themselves more on the electric auto subject and in turn impart such information to others. Creating a demand must come before consumption.

THE ELECTRIC GARAGE.[1]

BY S. P. REED.[2]

The maintenance of an electric garage is an absolute necessity in every locality where electrics are sold and used. This is true both from the standpoint of the owner and dealer.

Here is a common story. A man is taken out for a trial trip. As he nears home he expresses his entire approval and says he believes he understands how to operate the machine, and to read the meter. He asks the dealer to give the wife and daughter a trial spin. They, too, are enthusiastic, but the deal falls through in the end, not because they are not all anxious and willing to buy the machine, but the man discovers that he will have to charge and care for his own machine. He is wise enough to know that he has no training and the undertaking would prove a failure.

A gentleman in Palo Alto bought an electric for his daughter. He had a fine home garage fitted up and all went so well that he often took the electric to his office in preference to his gasoline car, as it was so much easier to start in the morning, but soon the charging plant developed difficulties, the car was left discharged for a long time, bringing on battery trouble and eventually the outfit was discarded.

Last year a Menlo Park resident bought an elegant coupe with a complete charging outfit and numerous instruction books, but as there was no one to properly interpret the instructions this outfit, too, was discarded.

Case after case might be cited, all going to prove that the dealer must have a garage in connection with the sales room, and not encourage the owner in the idea that he can take entire care of his machine. The average owner might charge his own car but when the difficulties arise, which are sure to come to the amateur, he ought to rely on a competent garage man.

Electric vehicles must not be sold where the owners cannot be in close touch with the electric garage. A man familiar with his own occupation, and having his time taken up with it cannot be expected to take up a new occupation and succeed with it, and this is what a dealer asks of his customer when he turns him over an electric with a charging plant and considers the deal closed. Usually all goes well for a short time, and the purchaser is enthusiastic. His friends and neighbors watch the new machine with interest and envy, but soon troubles arise which the unskilled owner cannot remedy—troubles which to the expert, were he near, would be little or nothing. Generally they develop into enormities and the electric is classed as a failure by the owner and his friends. This idea is spread in the vicinity and the sale of electrics is often held back in many fields that would be the best with the electric garage to rely upon for assistance.

The electric garage is really a school to teach people the pleasure and benefits of the electrics and to show them how small the troubles really are.

The electric garage is equally a benefit to the owners and the electric vehicle trade. It gives to one a perfect transportation and to the dealer a profitable and satisfactory vocation. The profits are not only from the first sale but from the operation of the garage. The business, especially on the Pacific Coast, has no dull season, electrics being used winter and summer. The electric is the cleanest vehicle made, and the garage is a clean, quiet place. The patrons as a rule are the better element in the vicinity, people who prefer quiet and cleanliness, and who are in good enough circumstances to meet their obligations promptly. With a good system and proper equipment the business is an ideal one.

The location of the garage is an important item. In the largest cities there will be garages in both residential and business districts. In the average town the garage will be half way between the business section and the residential. The reason for this is easily understood when we consider that the electric is pre-eminently the family car and is fast becoming the most

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Reed Electric Laboratory, San Jose.

popular machine in this particular field. Each and every member of the family can run the machine for themselves, so these same people must have the garage in a place where all may visit it. It should be on an open street with no street car lines and little traffic.

The chief attraction of the electric garage must be its cleanliness. The machine, itself, is clean and its home must correspond. There is no objection to the electric being housed in the vicinity of the most fastidious people. There is no noise, no deafening gasoline explosions, no oil smoke and no greasy floors with the usual expectations of fire.

True the electric will be delivered where wanted, but as many times as delievered it will be called for by members of the family who will meet friends at the garage, and this brings more customers.

The plans of every garage should include a well planned reception room for ladies and gentlemen, with especial accommodations for ladies. There have been, up to the present time, very inadequate accommodations at garages and there should be more attention paid to this feature. The ideal reception room will be near the door, not having the interior visible from the street, but it would be well to have glass doors on the show-room side.

The garage, if there is sufficient street space, ought to have an entrance and an exit—entrance on the right and exit on the left. This avoids confusion.

The show room might well be on the exit side. This for many reasons. When the machines come in they are often muddy and not as presentable as they might be.

The wash-room should be as near the door as possible. This saves the floor and prepares the machine for any repairs it may need. If there is no repair it can go at once to its stall in the charging or store room.

The charging room occupies the greatest amount of floor space in the garage. There will be no work done on the car in this room;; the wash room, tire room, battery room and repair shop being seperate rooms.

When a car is to be kept in a garage it is well to give it a number. This number should be used on every tag attached to the machine, on the charging stall, charging plug, owner's locker, in fact every thing pertaining to that particular car.

There are two approved methods of charging electric vehicles. One might be termed the central or collective, the other the individual.

In the central the readings are all taken at one central station, where is located the generating plant, the switchboard recording files and rheostats controlling the current to each machine. The instruments should consist of one voltmeter and two ammeters, one ammeter showing the total current, the other showing the individual current, having the bus-bars so arranged that the readings may be taken from any machine on charging. The only readings that cannot be taken here are the acid gravities and the voltages of the separate cells.

In the individual method the rheostats are placed back of each separate machine and the readings usually taken from the machine meter, though the current may be read from the main switchboard. Both systems have their merits. In both a careful tag system is universally used. On these tags is printed the records for each car. These records must be in detail, not only charging records are made but also records of repairs and performance. These records can be tabulated to prove the success of the electric vehicle and to prevent misunderstandings of accounts and so perform one of the most important details of the garage work.

The source of the power varies in different localities. There is nearly always a local power plant anxious to serve the electric garage especially if an agreement can be made whereby the garage used most of its current away from the peak of the company's load. This is naturally the time when the garage needs most of its current. The price, for this reason, ought to be less to the garage than to any other consumer. If direct current is supplied, a switchboard with regular rheostats is all that is needed. If the current is alternating, some method of transforming to direct is necessary. For the large loads or periods of large loads a motor generator set is best. For smaller loads the mercury arc rectifier is preferable.

In the isolated places the garage may generate its own current, there being on the market at the present time many reliable gasoline generating plants.

There should be rolling tables to take the batteries to the battery room, as it is not a good idea to take the machine where the paint, iron and upholstering will be subjected to the acid fumes.

The battery room as well as the charging room must be in charge of trained and competent men. These men, in fact, must be experts, as they are the main-stay of the electrical garage. The number of men required for each garage is said to be one expert for every 25 machines and one boy for delivering, to every 15 machines. There will, of course, be a day and night washer, machinist and a good manager. This with a book-keeper ought to complete the pay roll.

The other expenses in the garage will be the rent, insurance and power. The rent averages about $2 per month per machine and the current costs from $5 to $7 per month per machine. The help on the machine is not more than $6 per month. Owners, as a rule, carry their own insurance.

The receipts for charging and storing averages $25 per month. Repairs and sundries are extra. Adding to these sources of income, the profits on sales of new machines, a neat balance can be figured for the garage owner.

The electric garage deserves friends on all sides. The electric vehicle and storage battery manufacturers should show it every encouragement, for it is their chief outlet for their products. Every central station man loses his best load when he neglects it, and finally, let the people welcome it as it brings them the electric vehicle.

ELECTRIC AUTOMOBILES AND SURGERY.

Dr. H. Threlkeld-Edwards, director of St. Luke's hospital, South Bethlehem, Pa., is a gentleman of high professional attainments and many-sided culture, but among his different interests there are two that call out his keenest enthusiasm. One is his perfectly equipped X-ray laboratory, in which he applies clinically the discovery of the famous Roentgen to the great variety of surgical and medical cases that are constantly being treated at his hospital.

Another of the doctor's enthusiasms is the use for pleasure and professional duty of his Waverley electric automobile, in the care and handling of which he is an expert. What more natural then than that he should seek to connect these two pet hobbies of his by employing the storage battery of his electric for operating his X-ray instruments?

The suggestion is obvious enough, now that you read it. but who else besides an X-ray specialist and electrical expert would have thought of it? The doctor not only thought of it, he put it into immediate execution, and the results were fully up to his expectations. Here is his latest letter on the subject:

"Since last writing I have tried out the plan and am putting it in daily operation. It works perfectly, and its simplicity and 'can't go weary' properties make it most available for general adoption. I am quite confident that I can develop this idea into a most valuable asset for the Waverley Company, at the same time confer a still greater benefit on the medical profession in thus opening their eyes to a plan whereby they can secure an automobile capable of running up hills and through mud (I do it every day, for this is a very hilly locality), at a cost of current consumption of about $5 per month (my December bill was $3.80), and at the same time secure an X-ray plant by an additional outlay of less than $150 that will do the work of a coil and rectifier, etc., costing over $500, and be able to take the apparatus wherever the car will go. My total outlay for X-ray attachment is less than $130, including coil, condenser, interrupter, Mueller tube, stand and leads. I paid $750 for my office outfit running by short (alternating) current."

Now when you consider that this means providing an ever ready portable X-ray outfit for the up-to-date physician and surgeon at a cost of less than $150, it seems that the doctor has made a valuable discovery for the profession, and that one very great advantage of the electric vehicle for medical use has been demonstrated beyond peradventure.

CURRENT COMMENT

Carbide of tungsten as a solder for connecting incandescent lamp filaments to their supply wires has been recently patented by an Austrian inventor, Hans Kuzel, of Baden, near Vienna.

Long transmission of small power is necessary to supply the copper mines near Chilecite, Argentine, with electric power. A transmission plant has been built to carry 100 h. p. twenty miles because of the scarcity of fuel.

Butter by electrolyzing cream is a process recently patented by two Ohio inventors. Butter globules mass on a positive electrode suspended in cold cream, the current also having the necessary "ripening effect." The butter collected is aftewards worked into squares or rolls.

A praying car is to be provided for devout Mussulmen traveling to Mecca on the Hedjaz railway in Turkey. The car exterior is ornamented with a minaret 6½ feet high and the interior walls contain verses from the Koran and a chart indicating the direction of Mecca. A rich Persian rug is on the floor and four vessels of water are provided for ablutions.

An automobile as an electric power plant was recently put into service at the Vanderbilt Cup race. It was necessary to light the grounds with electric light and as no connections could be made with central station service, an automobile was mounted and attached by belt to a dynamo to furnish the current for fifty-five incandescent lamps of 110 volts, 16 candle power.

Low expansion metal has been discovered in 36% nickel steel. The expansion of this alloy is not greater than that of melted quartz and seventeen times less than that of steel. By varying the proportion an alloy can be obtained with the same expansion of glass, thus displacing platinum in incandescent lamps. It is non-magnetic and inoxidable. "Invar" is the trade name.

Silicon resembles carbon in being a poor conductor of electricity, and in having a negative temperature coefficient in resistance. It is thermoelectrically negative with respect to copper. At the mean temperature of 20° C. the thermoelectric power of a lead-silicon couple is —400 microvolts per degree. Under the same conditions a bismuth-lead couple gives —89 microvolts and an antimony-lead couple +26.

No automobile contests are to be entered by thirteen of the largest automobile works of Germany and France, who have come to an agreement not to participate in any big race or competitive contest during 1909. The penalty for violating the agreement is fixed at $20,000. This move is apt to put a damper on the speculation in constructing auto roads for racing purposes. The competitive races have caused heavy expenses to the automobile manufacturing works.

Tantalum has a melting point between 2,250 and 2,300° C. Its resistance increases with rise of temperature. At ordinary temperature the resistance of a wire one meter long and one square millimeter in section is 0.165 ohm. At the temperature of the incandescent lamp this figure becomes 0.85 ohm. The breaking strength of tantalum, when cold, is very great, being 93 kilos per square millimeter, as compared with from 70 to 80 kilos, for good steel. When heated, however, it becomes soft like osmium, and a filament, after burning for some time, is easily broken. The material is for incandescent filaments, the diameter being from 0.35 to 0.05 millimeter.

Telegraphing over power lines is described in L'Industrie Electrique by M. L. Neu, who uses a method of communication over high-pressure power lines by means of high-frequency currents, thus saving the expense of a separate telephone line. The principle is that of superposing a current of very high frequency upon the power currents, by means of a condenser, an inductance coil and a spark gap. The line pressure may be used to produce the sparks, or a small transformer, or a spark coil fed from a separate source. At the receiving end there is a spark-gap, in series with condensers and shunted by a relay, which may be used to close the circuit of a call bell. Communication is effected by Morse signals. Instead of using two line wires, one of them may be employed with earth return.

Electric crop forcing experiments are being conducted by Mr. J. H. Priestley, lecturer in botany at University College, Bristol, who has taken a great interest in studying the influence of electricity in increasing the yield of cereals, vegetables and fruits, and last year received through the college a grant from the Board of Agriculture to enable him to extend his investigations, according to the Electrical Engineer of London. As regards wheat, the results show that an electrified area of 7.675 acres yielded 249 bushels, 33 pounds, equal to 32.5 bushels per acre, while an unelectrified area of 10.2 acres yielded 26.4 bushels, 4 pounds, equal to only 26.15 per acre. As the current was not applied until May 17, this increase, which was due chiefly to the better filling out of the ears and plumper grain, was most satisfactory. The current, however, was applied too late to affect the number of ears. In the experiments with strawberries, it was proved that electricity brought about a great acceleration of the crops in the electrified area compared with the unelectrified area. On the first pickings there was 40 per cent more fruit gathered from the former. Through the dry season, and the tendency of electricity to increase the dryness, there was a slight falling off in the total yield of the electrified area compared with the other, but the fruit was very much sweeter, containing nearly twice the amount of sugar. In the experiment with tomatoes the yield from an electrified area was 30 per cent better than from the unelectrified area.

The Budapest news-telephone which has been in successful operation for several years past, is owned and managed by a private corporation, whereas the regular telephone system is owned by the government and administered by the ministry of posts and telegraphs. The annual subscription, $7.31, paid quarterly in advance, entitles the subscriber to two receivers and the full service of news, music, etc., the subscriber to pay the expense of installation and removal, generally about $8.50. The service begins at 8:55 a. m., when a buzzing noise, loud enough to be heard across a large room and lasting for fifteen seconds, announces the correct time. At 9:30 the day's programme of important events is announced; that is to say, the ceremonies, lectures, plays, races, etc. At 10 and 11 o'clock stock quotations and general news items are given. At noon comes a second announcement of the correct time, followed by parliamentary news and general items of interest. At 12:45 stock quotations from the local, Vienna, and Berlin exchanges and general news. At 2 o'clock more parliamentary and general news, and at 3 p. m. the closing prices of stocks, meteorological forecast, local personals and small items, and in winter the condition of the various skating places. At 4 p. m. court and miscellaneous news. From 4:30 to 6:30 military music from one of the great cafes or gardens. In the evening the subscriber may choose between the royal opera or one of the theaters, and later music by one of the orchestras. This programme is sufficiently varied to satisfy the desires of all classes of subscribers, and in general the service seems to give the utmost satisfaction.

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The discussion on papers read at the convention of the Pacific Coast Electric Vehicle Association will appear in our issue of March 6, 1909.

Low Rates For Vehicles

It was very evident at the convention of electric vehicle men held in San Francisco last week that few electric automobiles can be sold until lower rates for power are made by the central stations. The indifference of the central stations to the desirability of the electric automobile as a source of revenue is perhaps founded on prejudice. Their first impressions of a crude, imperfect machine, which like an unfledged bird is as yet untried, should not afterwards hinder its advancement, especially when it is a machine that has so greatly improved with time as has this. What with increased efficiency in running qualities and greater capacity of batteries, it is a far cry from the electric automobile of five years ago to that of today.

The electric car is distinctly a city machine, in direct contrast to the touring ability of the gasoline. The speed of the electric is greater than that ordinarily allowed by city regulations and its daily mileage capacity is in excess of the usual requirements for either business or pleasure. However, it is neither our intent nor our province to here advertise the electric carriage, but rather to demonstrate what a money-maker it may become for electric power companies.

A public garage, caring for thirty machines, has a current bill of from two hundred to three hundred dollars per month; home garages in proportion. An automobile uses more current for its storage batteries in one month than a cigar-lighter does in ten years. Furthermore, its current is consumed after midnight, off the peak, when costly apparatus would otherwise be idle while the interest on the investment piles up, water power runs to waste and depreciation continues. Here it is that the electric automobile does service as a grading machine in filling the "valleys" in the load curve. But little extra investment is required to supply the current needed. The demand is steady and it is permanent. The storage battery is probably the best automatic corrector of the load factor yet devised. It works while you sleep.

As the most desirable customer, the electric vehicle owner should also be the most favored, and as such entitled to a low rate for current. With a moderate current cost it is no more expensive to keep an electric car than a horse, and central station companies can do more good for themselves by encouraging the use of electric vehicles than in almost any other way. This encouragement may take several forms, including the use of commercial vehicles for trucking, and runabouts for collecting. But particularly may it be accomplished by lowering the power cost to a most beneficial consumer.

PERSONAL.

B. W. Traffort, vice president and general manager of the Bell Telephone Company's lines at Detroit, Michigan, is in San Francisco.

W. C. Bryant and Harvey Hubbell, accompanied by their wives, spent this week in San Francisco and are now in Southern California.

C. M. Clark, of Philadelphia, chairman of the executive committee of the Portland Railway, Light and Power Company, has been in Portland on his annual trip of inspection of the local properties of the company.

William Finn, of New York City, electrical expert for the Western Union Telegraph Company, reached San Francisco this week. Mr. Finn is making a study of the effects of high-tension transmission on telegraph lines.

C. G. Young, engineering and construction specialist of 60 Wall street, New York City, will be in the Philippine Islands, China, Japan and Siberia, from March until August, 1909. During Mr. Young's absence his office will be under the direction of his associate, J. N. H. Cornell.

L. B. Dixon, formerly with the telephone department of the Chicago office of the Western Electric Company, is in San Francisco with the intention of making his headquarters on the Coast, having resigned his position. Mr. Dixon is well known in the West because of his frequent trips here.

NORTHWESTERN CONSERVATION CONGRESS.

The first Conservation Congress for the Northwestern States will take place in Seattle on August 16-17-18. A call for the Congress has been issued by the Washington Conservation Association, one of the strongest State organizations in the country. Arrangements have been made for the entertainment of 1,000 delegates and the meetings will be held in the Auditorium on the grounds of the Alaska-Yukon-Pacific Exposition.

Through Acting Governor M. E. Hay the Governors of all the States will be asked to be in attendance at the Congress. Such men as Andrew Carnegie, Gifford Pinchot, Frederick Weyerhauser and others have already been extended invitations to participate in the Congress and according to C. H. Baily, Secretary of the Conservation Association, the convention will be the biggest thing of its kind ever held in the United States saving that of the Congress of Governors called by the President a year ago.

The Washington Conservation Association has engaged Aashel Curtis to go through the State and take a series of conservation photographs that, it is expected, will be second to none in the world. These will be exhibited in the exposition auditorium during the Congress. The views will include forestry, fisheries, irrigation and other phases of conservation work such as have heretofore never been assembled in the West.

Chambers of commerce, commercial clubs and other organizations in the State will be asked to name official delegations to attend the Congress, and through Lieutenant Governor Hay, the Governors of the States will be asked to name delegates.

The officers of the Conservation Association are: President, E. H. Libby, Clarkston and Spokane; Vice-Presidents, Joel Shomaker, Tukwila; Captain Everett G. Griggs, Tacoma; Oliver C. McGilvra, Seattle; Dr. N. G. Blalock, Walla Walla; I. A. Navarre, Wenatchee; Elmer E. Johnston, Everett; Secretary, C. H. Baily; Treasurer, Frederick Foster; Trustees, H. W. Carroll, Prof. Frank G. Miller, Walter N. Granger, W. W. Beck, L. G. Monroe.

ELECTRIC CLUB.

The regular weekly meeting of the Electric Club of California was held at noon, February 25, Hotel Argonaut, San Francisco. Dr. E. E. Baker of Cleveland, Ohio, gave a talk on the subject of Salesmanship, differentiating between the mere order-taker and the good salesman.

UNIFORMITY IN RATE CARDS.

The Technical Publicity Association, C. S. Redfield, advertising manager Yale & Towne Mfg. Co., President, has been asked by several leading trade papers for suggestions in the arrangement of their rate cards, with a view to putting these in a form most acceptable to the advertisers. In order to meet these requests, a committee has been appointed, consisting of the following: Messrs. Manfred, Snyder and Strong. The duties of this committee will be to propose a popular and uniform style of rate card and to recommend its use to the publishers of the leading trade papers.

TRADE CATALOGUES.

Folder 4122 from the Westinghouse Electric and Manufacturing Company is devoted to Electric Suction Sweeping.

February Bulletin of the Ohio Brass Company of Mansfield, Ohio, contains a valuable article on "Bonding in Mines."

General Electric Company's Bulletin, No. 4643, illustrates and describes two lines of switchboard instruments for direct current.

Electric Motor Friction Brakes are described and illustrated in Circular No. 1158 for the Westinghouse Electric and Manufacturing Company.

Bulletin No. 5533 from the Western Electric Company illustrates and describes a system of series incandescent lighting with tungsten lamps by means of automatic regulators.

The Duncan D. C. Integrating Wattmeter, House Type, Model E, is detailed by pictures and text in an interesting bulletin, No. 8, from the Duncan Electric Mfg. Co., Lafayette, Indiana.

Bulletin No. 23 from H. Krantz Manufacturing Company, of Brooklyn, N. Y., illustrates and describes in detail various types of high grade and commercial grade panel board switches and panel units.

Westinghouse Fan Motors for 1909 are attractively described in an artistic pamphlet, No. 1165, from the Westinghouse Electric and Manufacturing Company. The cover is one of the handsomest issued this year.

The General Electric Company has issued Bulletin No. 4644 which describes a motor generator set particularly suited for use in connection with searchlights, welding, for power work or as a reversible booster for battery service.

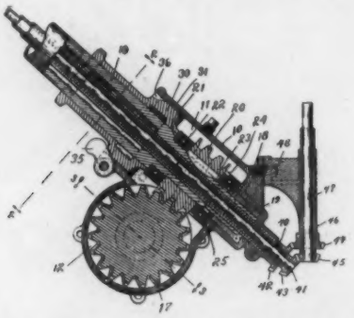
Mercury Rectifier Battery Charging Outfits are described in detail in Circular No. 1148 from the Westinghouse Electric and Manufacturing Company. It has been designed for automatic or non-automatic starting. Type A for automobile battery charging is illustrated and described in a separate leaflet.

In Bulletin No. 4641, just issued by the General Electric Company, are stated the advantages to be derived by the use of electricity in the lumber and wood working industries. The relative merits of alternating and direct current are briefly stated and a description is given of the plant of the Great Southern Lumber Company. The description includes numerous illustrations.

The General Electric Company has issued Bulletin No. 9640 devoted to large transformers, in which are given some of the more important points regarding the relative merits of the different types of large transformers manufactured by this company. This publication has to do with the oil cooled water cooled, and air blast transformers of large capacity, and contains illustrations of both the exterior and interior of various types.

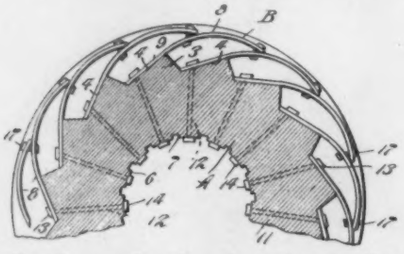
PATENTS

911,777. Steering-head for Automobiles. Harry C. Stutz, Indianapolis, Ind. In a steering head, the combination, with a worm wheel, a worm meshing therewith, and a shaft carrying said worm, of a pair of thrust bearings arranged at opposite ends of the worm to take the thrust thereof, one of said



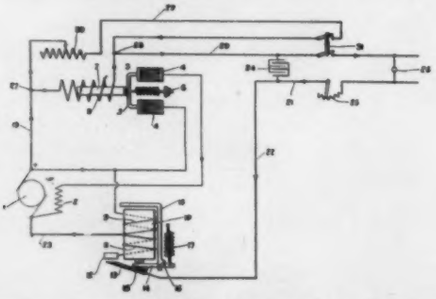
thrust bearings having one of its members threaded upon said shaft to serve as a retaining member for the worm, the direction of pitch of the threads being such that the thrust of the worm thereon will serve to tighten said retaining member on the worm, and abutments for said thrust bearings.

911,826. Vehicle-Wheel. Nathaniel G. Long, Elberton Ga. In a wheel, the combination of an annular body having a V-shaped groove, a plurality of springs rigidly secured at their ends to the bottom of the groove, and means for slidably



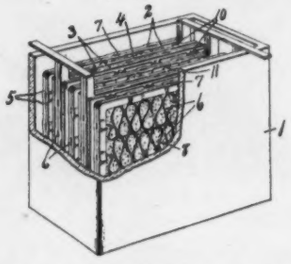
connecting the free ends of each spring to the intermediate portion of the adjacent spring, with a rubber tire extending around the body and bearing directly on the springs and entering the groove at opposite sides of the springs.

911,850. Battery-Charging System. William I. Thomson, Newark, N. J., assignor to The Safety Car Heating and Lighting Company. In apparatus of the class described, in combination, a source of current, a secondary battery in circuit there-with, a current utilizing device adapted to be put in cir-



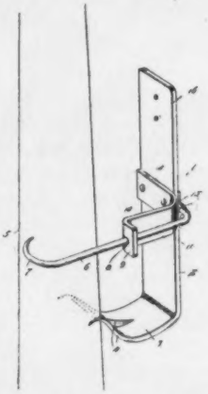
cuit therewith, means adapted to regulate the output of said source of current, said means comprising a solenoid, a shunt about said solenoid and a single means adapted substantially simultaneously to close the circuit of said shunt and throw said current utilizing device into circuit.

912,242. Electric Storage Battery. Henry K. Hess, Philadelphia, Pa., assignor of one-half to Thomas O. Peirce, Philadelphia, Pa. An electrode for storage bateries consisting of a substantially rectangular open frame composed of contacting lead strips secured together face to face, and a series of



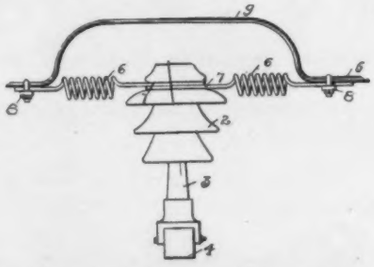
lead strips arranged in horizontal tiers, one above the other and having their ends interposed between the strips of the frame and their intermediate portions bent in the form of upright open loops.

912,123. Pole-Climber. Herman C. Hansen, Newcastle, Nebr. A pole climber comprising a supporting member having an upright approximately flat body, a brace of approximately right angular form attached to the inner face of the supporting member, with one portion thereof extending inwardly approximately at right angles thereform, the outer



end of said inwardly projecting portion terminating in an outstanding apertured lug, a catch connected with the body of the supporting member and extending through the apertured lug of the brace, the inner end of the catch terminating in a hook portion adapted to receive a pole.

911,973. Insulating High-Voltage Transmission-Lines. Walter T. Goddard, Victor, N. Y., assignor to The Lock Insulator Manufacturing Company, Victor, N. Y. The combi-



nation with a high voltage transmission line and a support connected with the earth, of an insulator and high resistance interposed in series between the line wire and the support.

INDUSTRIAL

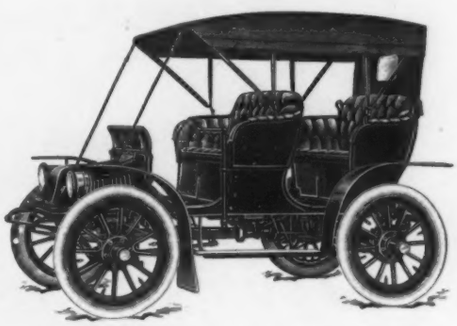
Babcock Runabout. Pacific Garage & Livery Company, San Francisco.

Battery—French, 100 miles.
Motor—High speed.
Speed—8 to 35 miles.
Upholstering—Leather.
Steering—Wheel.
Control—Foot lever.

Detroit Runabout, Model L. Western Electric Vehicle Company, Oakland, Cal.

Battery—16, 20 or 24 cells.
Wheels—Artillery type, 32".
Tires—3½" pneumatic.
Brakes—Motor and internally expanding hub plates.
Steering—Side lever or wheel.
Control—One lever.
Speed—8 to 21 miles per hour.
Mileage—60 to 80.
Weight—1700 pounds.
Upholstery—Leather.
Top—Cape.

Baker Surrey. Western Electric Vehicle Company, Oakland, Cal.

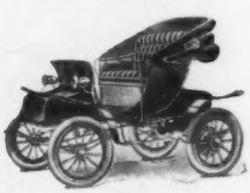


Battery—24 cells, 9 M. V. Exide.
Motor—Multiple, aluminum frame.
Drive—Side chain.
Wheels—Artillery, 30".
Tires—3½" front, 4" rear.
Upholstery—Cloth or leather.
Steering—Hinged side lever.
Control—Radial type.
Speed—5 to 20 miles per hour.
Body—Phaeton, top.

Rauch & Lang Stanhope. F. W. Pfaffman, Los Angeles, Cal.

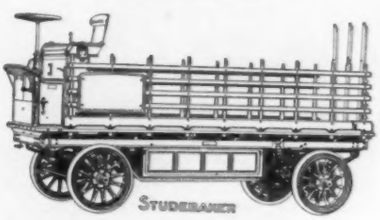
Battery—24 cells. 9. M. V. Exide.
Wheels—Artillery type, 32".
Tires—3½" Palmer web-pneumatic.
Brakes—Electric brake, motor brake and expanding hub.
Steering—Side lever.
Control—Continuous torque.
Speed—10 to 20 miles per hour.
Mileage—50 to 100 miles on normal speed.
Weight—1800 pounds.
Top—Hand-buffed enameled top, leather.

Columbus Victoria. Bay Cities Electric Company, Oakland, Cal.



Battery—28 cells, 9 M. V. Exide.
Motor—2½ h. p. 300% overload.
Drive—Shaft and bevel gear, silent chain reduction.
Wheels—Artillery, 36".
Tires—3½" front, 4" rear.
Upholstery—Broadcloth.
Steering—Side lever.
Mileage capacity — 40 on single charge.

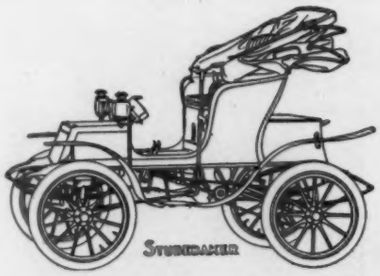
Studebaker Stake Truck. Studebaker Bros. Co., San Francisco.



Battery—44 cells, 19 plates.
Motors—Two (Westinghouse).
Wheels—36" in diameter.
Tires—6" single front, 4" dual rear.
Speed—7 miles per hour maximum.
Carrying space—Standard, 14' 6" long, 5' 6" wide.
Top—Any special design.
Capacity—10,000 pounds.

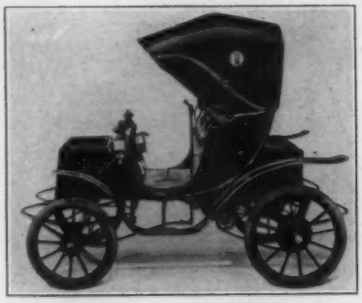
Cars Represented at Pacific Coast Electric Vehicle Association Convention at San Francisco February 19 and 20, 1909.

Studebaker Electric Doctor's Coupe. Studebaker Bros. Co., San Francisco.



Battery—28 cells, 9 plates.
Motor—Single (Westinghouse).
Drive—Herringbone gear and roller chains.
Wheels—30" diameter.
Tires—3½" front and rear.
Speeds—5, 8, 12, 15 miles per hour.
Upholstering—Cloth and leather.
Top—Coupe (interchangeable).
Steering—Side lever.

Woods Queen Victoria. Pacific Motor Car Company, San Francisco.



Battery—40 cells, 9 M. V.
Wheels—Artillery.
Drive—Side chain.
Tires—Solid rubber.
Speeds—4 speeds up to 18 miles per hour.
Mileage—50 on one charge.

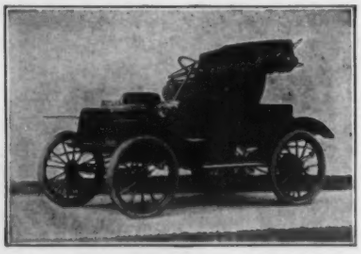
Waverley Victoria. Western Electric Vehicle Company, Oakland, Cal.

Battery—30 cells. Exide, National and Waverley.
Motor—One Waverley.
Wheels—30", wood.
Tires—4", detachable.
Speed—5 to 16 miles per hour.
Drive—Herringbone noiseless.
Brakes—Two foot, one electric.
Steering—Side lever.
Top—Coupe.

THE BABCOCK ELECTRIC AUTOMOBILE.

It is just about ten years ago since Edison predicted that in this length of time there would be practically no horses used upon the highways of the big cities of this country, and that the electric vehicle would have revolutionized both pleasure and commercial traffic. While "the wizard" has not accomplished the battery which would be the storer of commercial energy of which he then dreamed, yet tangible evidences of the comparative realization of his prediction have come in the presence here, at the time of the Electric Vehicle Convention last week at the St. Francis Hotel, San Francisco, of the 1910 Babcock electric victoria. This car was selected not only as the highest type of electric carriage, but the one capable of an exhibition run up the 16 per cent grade of California street hill last Saturday and negotiating it at 15 miles an hour, much to the surprise not only of the enthusiasts of the "electric," but of the gas-car representatives, as well.

The new Babcock has won the trophies in all electric stock-car contests during the past year in which it has been entered, and including such notable events as the Fort George Hill climb, New York City; the Stanley Hill climb, Cincinnati, O.; the treacherous hill climb at Williamsport, Penn.; the Arrowhead Hill climb, Long Island, N. Y.; the famous Wheaton Fair contest at Chicago, etc., and in many of which the "Babcock" beat the record of gasoline cars of national repute. In addition, this wonderful "electric" has made exhibition runs of from 110 to 120



miles on one normal charge of the battery, and last October made a 1,244 mile run through Illinois, without accident or a broken part.

When the car arrived in San Francisco the skeptics said it was "no use," that other "electrics" had endeavored to satisfactorily negotiate the hills of this city but abandoned their agencies for such level territories as Oakland and similar cities. The "Babcock" soon dissipated these pessemistic views, however, with astonishing exhibitions on the hills usually selected for the most strenuous demonstrations to be made by high-powered gasoline and steam cars.

The secret of the admitted success of this "Electric," is its new French-type of battery, which Mr. Babcock secured abroad a year ago, and which is standard in England, France and Germany; its new type of controller and by which all the energy delivered is utilized without waste; its exclusive high-speed motor; its lightness of construction, and a simple device for control, together with an irreversible steer, which give the "Babcock" a safety and simplicity heretofore unknown in "electric" vehicles. In addition to its unusual mile radius, the "Babcock" can be made to attain a speed of about 35 miles an hour, if desired, and a lady can drive it.

The "Babcock" has demonstrated that it not only combines more than a hundred miles on one charge with the usual speed of a gas car, but that it can duplicate its performance day after day without injury to its battery.

OGDEN, UTAH.—The water works committee of the City Council has its plans well under way for the improvement of the municipal system. The first work undertaken will be the Five Points extension which will require about 16,000 feet of 6-inch pipe. This will necessitate the purchase of about 10,000 feet of pipe as only 6,000 feet are on hand for the work.

NEW WIRING SUPPLIES BUILDING CONSTRUCTED BY THE GENERAL ELECTRIC COMPANY.

Ever since the first commercially successful incandescent lamp was placed upon the market, the manufacture of wiring supplies, such as sockets, receptacles, cutouts, switches, etc., has been a growing industry. It has kept pace with the many developments that have been made in the incandescent lamp, and today it is one of those branches of the electrical industry which may be classed as a distinct and separate art in itself.

With the increasing use of electricity for heating and power purposes the demand for wiring supplies has also

Fig. 1. Exterior Wiring Supplies Department Building.

increased to such an extent that their manufacture has grown to be a business of large proportions and importance and one requiring a high standard of inventive and constructive skill. In order to meet the demand the General Electric Company has recently constructed at its Schenectady plant a specially designed building for the manufacture of wiring supplies of all kinds.

The building, as shown in Fig. 1, is of modern fireproof construction and is thoroughly equipped in every respect for this class of work. It is four stories in height, 400 feet long, 85 feet wide in its narrowest dimensions and has a total floor space of about 150,000 square feet. Reinforced concrete is used throughout in the construction. The interior of the building is equipped with a fire extinguishing sprinkler system that appears adequate for a wooden structure of equal size.

Fig. 2. Shipping Floor Wiring Supplies Department Building.

All partitions are of reinforced concrete and asbestos wood, so that a very small percentage of combustible material enters into its construction. General Electric enclosed arc lamps with large corrugated reflectors furnish a well diffused light during the late hours of the day. At other hours ample natural illumination is afforded by numerous windows on each floor.

All machinery within the building is driven by electric motors, the motors being connected directly to the machine in a great many cases. High ceilings, pure air, plenty of daylight and ample working space are the favorable conditions under which the employees work. These conditions will be appreciated by those who know that better work can be done and more accomplished when the surroundings are healthful and inspiring. A lunch counter on the third floor is a further convenience for the employees. This enables the operatives to lunch within the building if they do not desire to go to the other works' restaurants.

Electrically operated passenger elevators are located at each end of the building. Freight is handled by a large

Fig. 3. General Offices Wiring Supplies Department.

electric elevator located in the center wing. Concrete stairways are provided near each elevator to give ready access to each floor.

In Fig. 2 is shown a view of the boxing and shipping department which occupies the first floor. Freight cars may be run from end to end of this floor and also to the center wing in which the large freight elevator is located. The elevator is of sufficient capacity to carry the cars to any floor.

The mechanical department occupies the second floor. This department contains a large number of electrically operated machines which are divided into several groups or divisions. Machinery for the production of dies, tools, moulds, etc., are grouped in one part of this floor, while presses for

Fig. 4. Exterior Porcelain Building.

punchings, metal casings, etc., are placed together. Automatic screw machines also form a separate group. Miscellaneous machine operations, including drilling, tapping, stamping, spinning, etc., are concentrated in another part of the room. A part of this floor is also divided off for polishing, dipping and plating operations.

The assembling department occupies the third floor. This floor is devoted entirely to the building up of the numerous parts into a complete and finished article ready for boxing

and shipping, and has accommodations and facilities for about 1,000 operatives. The assembling operations on this floor are also divided into several divisions. For instance, socket and receptacles are assembled in one section and cutouts and attaching plugs in another. The same may be said of fuse plugs, snap push button and small knife switches, enclosed and open type fuses and distribution cabinet panels. Here also the sealing and pitching operations are performed. On this same floor the assembled devices are placed in boxes and labelled.

The offices of the department are situated on one end of the fourth floor. Fig. 3 shows the offices of the managing engineer and his force of designing engineers, draughtsmen, production clerks, and cost clerks. On this floor facilities are also provided for electrical and mechanical testing of the completed devices and for the production of models. A force of experienced model makers are daily engaged in making up preliminary models from which the moulds, dies, and tools are formed for the production of the finished article.

The productive capacity of the Wiring Supplies Building, if worked to what may be termed its maximum full load output, would be about one million five hundred thousand separate and complete devices every week. This output represents a diversity of devices, such as key and keyless sockets and receptacles designed to meet every conceivable condition of service and for every variety of series and multiple lamps of all shapes, sizes and candlepower; automatic safety cutouts, enclosed and open type fuses, non-magnetic and magnetic blow-out types for all currents and voltages, and for use wherever automatic protection is required; surface snap switches of all capacities, with and without indicating features for all classes of open and concealed wiring; flush pocket snap and pendant switches, and wall push button types, and ceiling and knife blade switches for every service with and without fuses. Cabinet panel boards for all classes of wiring, and for all voltages and currents are also manufactured together with attachment and connection plugs for lighting and heating service.

Some idea of the operations involved and the labor and material required in a "rush week" output may be obtained when it is remembered that each device is made up of several materials, including porcelain, copper, brass, bronze, fibre, mica, etc., and each separate part is created from the crude material, and shaped, stamped, drilled, tapped and finished by appropriate processes and machinery. The numerous parts are accurately and securely assembled together, and representative samples of each line are periodically tested for mechanical durability and also for electrical endurance under overloads which represent the very worst conditions of actual service. These tests are made so as to satisfactorily fulfill certain specifications of design and service, and also to secure the approval of the factory inspection system.

An exterior view of the buildings in which the porcelain and compound parts are made is shown in Fig. 4. These buildings are directly opposite the Wiring Supplies Building and only a few hundred feet distant. This is a very valuable convenience, as it enables porcelain and compound parts to be transferred to the Wiring Supplies Building as quickly as they are needed.

In this connection, it is interesting to review the early history of the manufacture of wiring supply devices, and to contemplate the smooth and unhindered progress of the early manufacture of these devices, and their freedom from competition and from the examination and scrutiny of the city and insurance inspectors.

The first commercial lamp socket was designed and used about thirty years ago. It was cylindrical in form and made of cherry wood. Two metal contact strips arranged diametrically opposite each other made contact with two similar strips on the lamp base. A few years later the present screw shell form of contact was invented and proved such a simple and effective means of conducting the current to the lamp, at the same time securely holding the lamp within the socket, that it has remained to the present time the accepted standard method of attaching lamps, attachment plugs and fuse plugs to sockets, receptacles and plug cutouts.

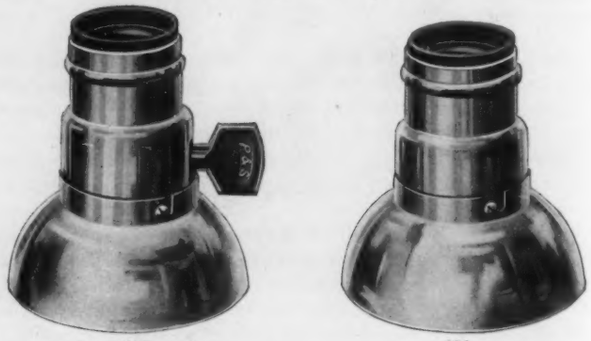
At this period receptacles, cutouts and switch bases were also made of cherry or apple wood. It was of course quite natural that the early designer of wiring devices should have selected wood as the most suitable material from which to make the bodies and bases of these small fittings. Wood of all varieties was everywhere available at small cost. Other materials which have since replaced wood for these details were not then considered within the reach of manufacturers in quantities and price that would compare with wood, especially as wood was capable of being easily machined and shaped to any desired form, and filled, treated and protected to meet any peculiar conditons of service.

During the year 1883, however, slate and porcelain were applied to commercial forms of lamp fittings, and has now for some time replaced wood with its serious disadvantages of warping, splitting and carbonizing under high temperatures.

NEW DEVICES FROM PASS & SEYMOUR.

Pass & Seymour, Incorporated, Solvay, N. Y., have several new devices which they are presenting to the trade, and which are illustrated herewith.

P. & S. No. 480 and 481 are to replace the old style removable rubber ring fastening, which style the Underwriters

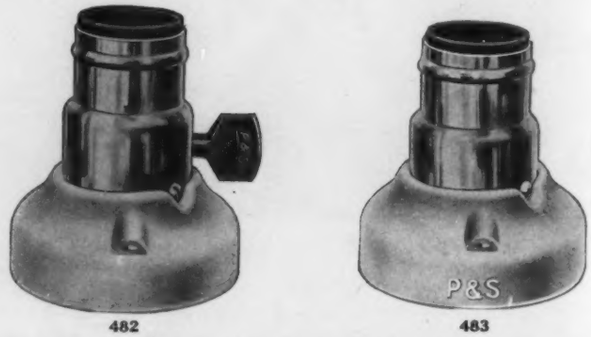


480 481

do not sanction. The base is recessed to allow for the projection of tubes or conduit ends.

Nos. 482 and 483 also have this latter feature, but with the all porcelain base as illustrated.

These devices being used for concealed work will naturally have to cover an opening in the wall. In the past all devices of this type have been made with bases too small and the screw holes have been so located that it was difficult for the receptacle to be properly fastened. In these



482 483

types the large bases with the consequent wide separation of the supporting screw holes take care of this possible condition and insure a workmanlike job.

The price is not high and the quality is the same as that which characterizes all Pass & Seymour goods, namely, nothing but the best.

NEWS NOTES

FINANCIAL.

PASADENA, CAL.—Bonds amounting to $150,000 have been issued for the purpose of enlarging the municipal lighting plant.

MESA, ARIZONA.—An ordinance has been passed by the city trustees providing for the issuance of bonds amounting to $50,000 for the purpose of constructing water works for the city of Mesa.

SAN FRANCISCO, CAL.—The tenders of the Pacific Gas and Electric Company 5% bonds for the investment of $250,902.77 in the sinking fund, just opened, indicate, in all $843,000 bonds tendered from 85 to 105 and $286,000 were taken from 85 to 88.65, the average being 87.7916, or about eight points higher than last year.

SAN FRANCISCO, CAL.—Hon. W. F. Chandler, one of the directors of the Associated Oil Company, states that in all probability the company will pay dividends beginning about August. No fixed rate of payment will be declared but dividends will be paid at such times as the directors deem advisable. The annual meeting of the directors of the company will be held this week and maters concerning the granting of dividends will be discussed at that time.

SAN FRANCISCO, CAL.—The Assessors of San Francisco, Alameda and Santa Clara Counties have filed with the Board of Supervisors statements of the assessed valuation of the Spring Valley Water Company in the various counties for use in connection with the rate making investigation. The report from the Assessor of Alameda is as follows: Real estate, $386,300; improvements, $32,900; personal property, $4,100,000; total $4,519,500. The statement for San Francisco County is: Real estate, $1,330,380; improvements, $648,280; personal property, $912,507; total, $8,889,167. The Assessor for Santa Clara County reported a total assessment of $69,990. The totals for the three counties amount to $13,478,657.

SEATTLE, WASH.—The report of the Seattle Electric Company for the month of December and twelve months ended December 31 compares as follows:

	1908	1907
December gross	$ 415,079	$ 376,805
Expenses	253,801	229,582
December net	$ 161,278	$ 147,223
Charges and taxes	83,802	76,689
Balance	$ 77,475	$ 70,534
Bond sinking fund	11,511	7,280
December surplus	$ 65,964	$ 63,254
Twelve months, gross	4,520,488	4,119,724
Expenses	2,670,252	2,421,404
Twelve months, net	$1,850,236	$1,698,320
Charges and taxes	989,374	832,941
Balance	$ 860,862	$ 865,380
Bond sinking fund	101,271	87,360
Twelve months, surplus	$ 759,591	$ 778,020

SAN FRANCISCO, CAL.—On the motion of the Knickerbocker Trust Company of New York, Geo. H. Whipple has been appointed receiver for the Stanislaus Electric Power Company and Vanderlynn Stow receiver for the Tuolumne Water Power Company. This is another move toward the combining of the two companies and the formal taking over by the United Railroads. By the terms of the sale the present $6,000,000 issue of first mortgage bonds of the Stanislaus company are to be surrendered for second mortgage 40-year, 5 per cent bonds, non-foreclosable before July 1, 1914, the stock of the reorganized Stanislaus company is to go to the United Railways Investment Company in exchange for $900,000 of preferred stock and $900,000 of common stock at par. First mortgage Stanislaus bonds to the amount of $5,500,000 will be issued to complete the hydro-electric property and not more than $1,000,000 additional bonds to develop the distributing system. Energy will be supplied for 44 years at 7.5 miles per k.w.-hour. The new power company will have a peak capacity of 48,000 k. w. under the present plans.

INCORPORATIONS.

LOS ANGELES, CAL.—The Hannon Water Company has been formed here with a capital stock of $6,000 by F. A. J. V., C. D., J. E., and F. Hannon.

LOS ANGELES, CAL.—The Soquel Canyon Oil Company has been incorporated here with a capital stock of $20,000 by R. W. Poindexter, T. S. Wadsworth and M. F. Brack.

LOS ANGELES, CAL.—The Perry Electrical Works has been incorporated here with a capital stock of $100,000 by Robert March, A. S. and L. Perry, H. E. and H. A. Hayden.

HANFORD, CAL.—The Lillian Oil and Mining Company has been incorporated here with a capital stock of $100,000 by S. Rehoefer, E. E. Bush, F. Richardson, C. E. Chastine and Jos. Barbeiro.

LOS ANGELES, CAL.—The Yucaipa Water and Lumber Company has been incorporated here with a capital stock of $100,000 by G. D. Bailey, G. E. Fairhead, E. M. Giffen, L. R. Wharton and F. A. Holmes.

NAPA, CAL.—The Forest Park Land and Water Company has been incorporated here with a capital stock of $200,000 for the purpose of buying and selling land, owning reservoirs, etc. The incorporators are: A. P. Cross, railroad promoter of Los Angeles, Attorney John L. McNab of Ukiah, and William Kirk of Napa.

SAN FRANCISCO, CAL.—The San Francisco Electric Railways has been incorporated with a capital stock of $10,000,000, to build two and one-half miles of street railway in this city. The articles not only state the route which the new line will take through the city but they also give the company the general right to build on other streets not named. The incorporators of the company are: Lewis F. Byington, Frederick V. Scott, John R. Tyrrell, John F. Forbes and W. H. Orrick. John F. Forbes has been chosen treasurer of the corporation.

TRANSMISSION.

BREMERTON, WASH.—The Peninsula Light and Power Company has a contract to supply light and power to the Bremerton Navy Yard.

MISSOULA, MONT.—Several water rights in this vicinity have been secured by the Idaho Water and Electric Power Company preparatory to building a power plant.

REDONDO, CAL.—The steel pier and 600 feet of approach to the Starr Wave Motor Company's plant was entirely destroyed by the high seas which prevailed last week. The pier and machinery cost upwards of $100,000. The company has not announced its intention of rebuilding the plant.

BAKERSFIELD, CAL.—The Edison Electric Company's electric power plant in the Kern River Canyon was so badly disabled by the severe storms of the past few weeks that it has become necessary to shut down until the necessary repairs can be made. Rush orders have been sent for new generators and repairs will be hastened as fast as the machinery arrives.

TELEPHONE.

OAKLAND, CAL.—Bids for the sale of a telephone franchise outside of the incorporated towns of Alameda county were called for by the board of supervisors this week and will be opened March 29.

SAN FRANCISCO, CAL.—At the annual meeting of the Pacific Telephone and Telegraph Company of which 55 per cent of the capital stock is owned by the American Bell Telephone Company, the following directors were elected: H. T. Scott, J. C. Ainsworth, F. C. Bradley, F. J. Carolan, J. C. Cebrian, Edward Coleman, W. H. Crocker, F. G. Drum, F. W. Eaton, M. Ehrman, Louis Glass, Geo. D. Greenwood, Timothy Hopkins, Homer S. King, Theodore N. Vail, O. J. Woodward and E. J. Zimmer. The board of directors have organized and chosen Henry T. Scott, president; E. C. Bradley, vice president and general manager; E. J. Zimmer and Louis Glass, vice presidents; and F. W. Eaton, secretary and treasurer. The surplus earned during the year, over all expenses, fixed charges and dividends, on the preferred stock, amounted to $695,471.04, or nearly 4 per cent on the common stock.

ILLUMINATION.

OKANOGAN, WASH.—A light and power plant for this city may be built by R. P. Rodemyer of La Crosse, Wis.

ST. JOHNS, OREGON.—Extensive additions may be made to the gas plant here. C. R. Donnell is secretary of the company.

STOCKTON, CAL.—The Stockton Gas and Electric Company has been granted a franchise to lay gas pipes in the streets of this city.

ALAMEDA, CAL.—The Electricity Commission of this place has plans for the addition of at least 150 additional electric street lamps.

GRASS VALLEY, CAL.—The Pacific Gas and Electric Company announces that it will soon begin installing electric light and power meters in Grass Valley and Nevada City.

LEMOOR, CAL.—The board of trustees have advertised for sale the present municipal electric light and power plant with all personal property belonging thereto. Bids will be received until March 1st, 1909.

LOS ANGELES, CAL.—C. S. Chestnut, of Redlands, has become sole owner of the Colton Gas Company. Mr. Colton will enlarge the capacity of the plant so that the company can supply the several near-by cities.

MOSCOW, IDAHO.—The City Council has granted Andrews & Clark a gas franchise, provision being made that work shall begin within sixty days and that not less than $3,000 shall be expended within six months.

GLENDALE, CAL.—Frank Campbell, L. C. Brand, J. F. McIntyre and D. Griswold of Glendale are planning to form a company with a capital stock of $150,000, for the purpose of furnishing electricity and gas to this town.

ANAHEIM, CAL.—The Anaheim Gas Company has purchased for upwards of $100,000 the gas company of Orange. The works will probably be moved to Anaheim, and the consumers of Orange served by a pipe line from Anaheim.

SILVER CITY, N. M.—The New Mexico Light, Heat and Power Company has been purchased by J. B. Downey, of Denver, Colorado. Mr. Downey states that the entire plant is to be improved and that upwards of $15,000 will be spent in putting it in first class condition.

EUREKA, CAL.—At the annual meeting the stockholders of the Humboldt Gas and Electric Company, the following directors which held office during the past year were re-elected: W. S. Clark, J. M. Carson, Henry Deering, George Murry and H. Vance. The company plans during the coming year to increase the capacity of its plant at Junction City on the North Fork of the Trinity River.

SALT LAKE CITY, UTAH.—The Utah Light and Railway Company is planning to make improvements to its plant which will cost in the vicinity of $500,000. Plans are being made for ordering a second 75-ton, 3,000 horse power, motor-generator costing $35,000. An emergency plant is also to be erected at the Jordan River, with steam power equal to one-half the total demands now made on the present plant. The engines to be installed here are to be of the turbine pattern, those being found the most economical in operation.

TRANSPORTATION.

LOS ANGELES, CAL.—H. F. Vollmer has been granted a franchise by the City Council for a double track electric road on certain streets in this city.

LOS ANGELES, CAL.—Sealed bids will be received by the City Council up to March 23, 1909, for a twenty-one-year double track electric street railway on certain streets of this city.

SACRAMENTO, CAL.—George W. Peltier, of the Central California Traction Company, which line is now in operation between Stockton and Lodi, announces that the company intends building and completing before the end of the year its proposed line in Sacramento.

OIL.

LOS ANGELES, CAL.—It is reported here that the Standard Oil Company has decided on the early installation of fifty new drilling rigs at an outlay of $250,000 and an expenditure of fully $500,000 in the development of oil wells in the territory tributary to this city.

SAN FRANCISCO, CAL.—The following cargo shipments of refined petroleum were made in January to the Orient from this customs district, all but the last mentioned, which cleared for China, going to Japan: Tuscora, 2,291,844 gallons, valued at $103,128; Winnebago, 1,900,000 gallons, valued at $85,500; Ashtabula, 2,246,460 gallons, valued at $110,091; and Tonawanda, 1,800,000 gallons, valued at $81,000; total, 8,238,313 gallons, valued at $379,719. During the same month there were the following three clearances of fuel oil for the Orient, the first being for Chile, the second for Honolulu and the other for Panama: Santa Maria, 1,680,000 gallons, valued at $24,000; Fullerton, 630,000 gallons, valued at $9,000; and Lansing, 1,680,000 gallons, valued at $24,000; total, 3,990,000 gallons, valued at $57,000. The records show an increase of nearly five million gallons in refined oil and of about a quarter of a million gallons in fuel as compared with January, 1908.

WATER WORKS.

OAKLAND, CAL.—The City Council at its last meeting decided on the reduced water rate partially arranged for at the preceding meeting. It is claimed that the total saving to the city will reach $800,000.

BAKERSFIELD, CAL.—Oil men on the West side are signing contracts for a year's supply of water at four cents a barrel with a new company promoted by R. B. McCauley of Los Angeles, who is said to be backed by English capital. The plan is to pipe water from Pine Mountain, 40 miles south of Midway.

SAN DIEGO, CAL.—Plans are under way for laying almost four miles of new water mains in Ocean Beach Park. The Board of Public Works has recommended to the City Council the purchase of $75,000 worth of cast iron pipe to be used in extensions in various parts of the city. The funds for the improvements were provided for in a bond issue voted in 1907.